2815-220-34/190

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR ENGINE WITH CONTAINER: TURBOSUPERCHARGED, DIESEL, FUEL INJECTION, 90-DEGREE "V" TYPE, AIR-COOLED, 12 - CYLINDER, ASSEMBLY; MODELS AVDS-1790-2C 2815-00-410-1203 AND AVDS-1790-2D 2815-00-410-1204

This copy is a reprint which includes current pages from Changes 1 through 5.

HEADQUARTERS, DEPARTMENT OF THE ARMY

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CHANGE No. 5

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *10 August 1988*

Direct Support and General Support Maintenance Manual For ENGINE WITH CONTAINER: TURBOSUPERCHARGED, DIESEL, FUEL INJECTION, 90-DEGREE "V" TYPE, AIR-COOLED, 12 — CYLINDER, ASSEMBLY;

MODELS AVDS-1790-2C, (NSN 2815-00-410-1203), AVDS-1790-2D, (NSN 2815-00-410-1204) AVDS-1790-2DR, (NSN 2815-00-124-5387) MODELS AVDS-1790-2CA (NSN 2815-01-149-1353) AND AVDS-1790-2DA (NSN 2815-01-166-2051)

TM 9-2815-220-34, 20 December 1975, is changed as follows:

Remove old pages and insert new pages as indicated below. New or revised material is indicated by a vertical bar in the margin of the page. Added or revised illustrations are indicated by a vertical bar adjacent to the identification number.

Remove pages	Insert pages
2-34.1/(2-34.2 blank)	2-34.1/(2-34.2 blank)
2-37 and 2-38	2-37 and 2-38
2-43 and 2-44	2-43 and 2-44
2-61 and 2-62	2-61 and 2-62
2-67 and 2-68	2-67 and 2-68
2-78.1/(2-78.2 blank)	2-78.1/(2-78.2 blank)
2-90.1/(2-90.2 blank)	2-90.1 and 2-90.2
None	2-90.3 through 2-90.6
2-91 and 2-92	2-91 and 2-92
2-94.1 and 2-94.2	2-94.1 and 2-94.2
3-1 and 3-2	3-1 and 3-2
3-204.1 and 3-204.2	3-204.1 and 3-204.2
None	3-204.3 and 3-204.4
None	3-206.1 and 3-206.2
None	3-208.1 through 3-208.3/(3-208.4 blank)
None	3-212.1 and 3-212.2
None	3-214.1/(3/214.2 blank)
3-215 and 3-216	3-215 and 3-216
3-217 and 3-218	3-217 and 3-218
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3-245 and 3-246	3-245 and 3-246
Index 17	Index 17

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-37, Direct and General Support Maintenance requirements for Vehicle, Recovery, Medium, Full Tracked, M88A1; Tank, Combat, 105-MM, M60; Vehicle, Combat Engineer, Full Tracked, M728; Tank, Bridge Launcher, M60A1 (AVLB), Tank, Combat, Full Tracked, 105-MM, M60A3 and TTS; Tank, Combat, Full Tracked, 105-MM, M60A1 RISE and M60A1 RISE PASSIVE, and Tank, Combat, Full Tracked, 105-MM, M48A5.

WARNING

The valve cover is spring loaded. Exercise care when removing cover (para 2-33).

WARNING

The ignition units on this engine are capable of producing extremely high voltage. The output of this ignition system is sufficient to cause a dangerous electrical shock. Never touch any uncovered or live connections (para 2-42).

WARNING

It is recommended that all nozzles be removed when performing a compression check. Nozzle removal will prevent the possibility of the engine firing on other cylinders when the engine is cranked, and will permit the engine to be cranked at the desired RPM to check compression (para 2-51*a*).

WARNING

Particles blown by compressed air are hazardous. Make certain air stream is directed away from user and that other persons are not exposed. Protect eyes and face with appropriate shields (para 3-36*b*(4)).

WARNING

Use goggles, rubber gloves, and rubber apron when cleaning parts in carbon removing compound. Provide adequate ventilation. Avoid inhalation of fumes and skin contact. If compound is splashed on skin, flush with fresh water and wash with alcohol. Alcohol containing 2 to 3 percent campher is preferable (para 3-64*a*).

WARNING

The valves and locks are under heavy spring tension. Exercise extreme care when removing locks, retainers and springs (para 3-69*a*(2)).

WARNING

Injection pump advance assembly will be hot following test. Operator should wear gloves when removing unit from test stand (para 3-99*c*(15)).

WARNING

The penetrating power of atomized fuel under pressure is sufficient to puncture the skin and cause blood poisoning. Keep hands away from nozzle during test (para 2-48*b*(1)).

CHANGE

No. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *22 September 1985*

Direct Support and General Support Maintenance Manual For ENGINE WITH CONTAINER: TURBOSUPERCHARGED, DIESEL, FUEL INJECTION, 90-DEGREE "V" TYPE, AIR-COOLED, 12-CYLINDER, ASSEMBLY;

MODELS AVDS-1790-2C, (NSN 2815-00-410-1203),
AVDS-1790-2D, (NSN 2815-00-410-1204)
AVDS-1790-2DR, (NSN 2815-00-124-5387)
MODELS AVDS-1790-2CA (NSN 2815-01-149-1353)
AND

AVDS-1790-2DA (NSN 2815-01-166-2051)

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Remove pages	*Insert pages*
None	Index 9 and 10
None	Index 13 through 17

2. File this change sheet in front of the publication for reference purposes.

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JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

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Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-37, Direct Support and General Support Maintenance requirements for Vehicle, Recovery, Medium, Full Tracked, M88A1; Tank, Combat, Full Tracked, 105-MM, M60; Vehicle Combat Engineer, Full Track, M728; Tank, Bridge Launcher, M48A5 (AVLB); Tank, Combat, Full Tracked, 105-MM, M60A1, RISE and RISE PASSIVE; Tank, Combat, Full Tracked, 105-MM, M48A5 and Tank, Combat, Full Tracked, 105-MM, M60A3 and TTS.

END ITEM APPLICATION

Engines AVDS-1790-2C, AVDS-1790-2CA, AVDS-1790-2D, and AVDS-1790-2DA

Vehicles	TM No. Series
Tank, Combat, Full Tracked: 105-MM Gun, M48A5	9-2350-258
Tank, Combat, Full Tracked: 105-MM Gun, M60 and M60A1	9-2350-215
Tank, Combat, Full Tracked: 105-MM Gun, M60A1 (RISE)	9-2350-257
Tank, Combat, Full Tracked: 152-MM Gun, M60A2	9-2350-232
Tank, Combat, Full Tracked: 105-MM Gun, M60A3	9-2350-253
Armored Vehicle Launched Bridge: M48A2 AVLB	5-5420-200
Armored Vehicle Launched Bridge: M60A1 AVLB	5-5420-202
Armored Vehicle Launched Bridge: M48A5 AVLB	5-5420-226
Vehicle, Combat Engineer, Full Tracked: M728	9-2350-222

Engine AVDS-1790-2DR

Vehicles	TM No. Series
Recovery Vehicle, Full Tracked: Medium, M88A1	9-2350-256

TM 9-2815-220-34
C3

CHANGE
No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *26 October 1984*

Direct Support and General Support Maintenance Manual For ENGINE WITH CONTAINER: TURBOSUPERCHARGED, DIESEL, FUEL INJECTION, 90-DEGREE "V" TYPE, AIR-COOLED, 12-CYLINDER, ASSEMBLY; MODELS AVDS-1790-2C, (NSN 2815-00-410-1203), AVDS-1790-2D, (NSN 2815-00-410-1204) AVDS-1790-2DR, (NSN 2815-00-124-5348) MODELS AVDS-1790-2CA (NSN 2815-01-149-1353) AND AVDS-1790-2DA (NSN 2815-01-166-2051)

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Remove pages	*Insert pages*
c/d blank	c/d blank
i and ii	i and ii
1-1 through 1-10	1-1 through 1-10
None	1-10.1 through 1-10.3/(1-10.4 blank)
1-11 through 1-22	1-11 through 1-22
1-22.1 and 1-22.2	1-22.1 and 1-22.2
1-23 and 1-24	1-23 and 1-24
2-1 and 2-2	2-1 and 2-2
2-9 through 2-10.8	2-9 through 2-10.8
2-11 through 2-14	2-11 through 2-14
2-17 through 2-28	2-17 through 2-28
2-31 through 2-34.1/(2-34.2 blank)	2-31 through 2-34.1/(2-34.2 blank)
2-35 through 2-36.1/(2-36.2 blank)	2-35 through 2-36.1/(2-36.2 blank)
2-37 through 2-40	2-37 through 2-40
2-43 through 2-50	2-43 through 2-49/(2-50 blank)
2-51 through 2-62.1/(2-62.2 blank)	2-51 through 2-62.1/(2-62.2 blank)
2-63 and 2-64	2-63 and 2-64
2-67 and 2-68	2-67 and 2-68
None	2-68.1/(2.68.2 blank)
2-69 through 2-70.3/(2-70.4 blank)	2-69 through 2-70.3/(2-70.4 blank)
None	2-70.4.1 and 2-70.4.2
2-73 through 2-78.1/(2-78.2 blank)	2-73 through 2-78.1/(2-78.2 blank)
2-79 through 2-80.1/(2-80.2 blank)	2-79 through 2-80.1/(2-80.2 blank)
2-81 through 2-86.2	2-81 through 2-86.2
2-87 through 2-90	2-87 through 2-90
None	2-90.1/(2-90.2 blank)
2-91 and 2-92	2-91 and 2-92
2-94.1 and 2-94.2	2-94.1 through 2-94.3/(2-94.4 blank)
2-95 and 2-96	2-95 and 2-96
2-96.3 through 2-96.5/(2-96.6 blank)	2-96.3 through 2-96.5/(2-96.6 blank)
3-1 through 3-4.3/(3-4.4 blank)	3-1 through 3-4.3/(3-4.4 blank)
3-5 through 3-6.1/(3-6.2 blank)	3-5 through 3-6.1/(3-6.2 blank)
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3-87 and 3-88	3-87 and 3-88
None	3-94.1 and 3-94.2
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3-172.1 through 3-172.4	3-172.1 through 3-172.4
3-173 through 3-174.1/(3-174.2 blank)	3-173 through 3-174.1/(3-174.2 blank)
3-175 through 3-178	3-175 through 3-178
None	3-178.1/(3-178.2 blank)
3-179 through 3-187/(3-188 blank)	3-179 through 3-187/(3-188 blank)
3-189 through 3-192	3-189 through 3-192
3-193 and 3-194	3-193 and 3-194
3-197 through 3-198.1/(3-198.2 blank)	3-197 through 3-198.1/(3-198.2 blank)
3-201 through 3-202.2	3-201 through 3-202.2
3-203 through 3-204.1/(3-204.2 blank)	3-203 through 3-204.2
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3-223 through 3-228	3-223 through 3-228
3-235 through 3-240.1/(3-240.2 blank)	3-235 through 3-240.1/(3-240.2 blank)
3-241 and 3-242	3-241 and 3-242
None	3-242.1 and 3-242.2
3-243 and 3-244	3-243/(3-244 blank)
3-245 through 3-248	3-245 through 3-248
None	4-1 through 4-14
Index 1 through Index 8	Index 1 through Index 8
Index 11 and Index 12	Index 11 and Index 12
Index 15 and Index 16	Index 15 and Index 16

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JOHN A. WICKHAM, JR.
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Brigadier General, United States Army
The Adjutant General

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TM 9-2815-220-34
C 2

CHANGE }
No. 2 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *26 December 1980*

Direct Support and General Support Maintenance Manual For ENGINE WITH CONTAINER: TURBOSUPERCHARGED, DIESEL, FUEL INJECTION, 90-DEGREE "V" TYPE, AIR-COOLED, 12 — CYLINDER, ASSEMBLY; MODELS AVDS-1790-2C, (NSN 2815-00-410-1203), AVDS-1790-2D, (NSN 2815-00-410-1204) AND AVDS-1790-2DR, (NSN 2815-00-124-5387)

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1-1 through 1-10	1-1 through 1-10
1-13 through 1-16	1-13 through 1-16
1-19 through 1-22	1-19 through 1-22
None	1-22.1 and 1-22.2
1-23 and 1-24	1-23 and 1-24
2-1 through 2-4	2-1 through 2-4
2-7 through 2-10	2-7 through 2-10
2-10.1 through 2-10.6	2-10.1 through 2-10.8
2-11 and 2-12	2-11 and 2-12
2-23 and 2-24	2-23 and 2-24
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2-29 through 2-34	2-29 through 2-34
2-34.1	2-34.1 (2-34.2 Blank)
2-35 and 2-36	2-35 and 2-36
None	2-36.1 (2-36.2 Blank)
2-37 through 2-52	2-37 through 2-52
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2-70.1 through 2-70.8	2-70.1 through 2-70.8
2-73 through 2-78	2-73 through 2-78
2-78.1 (2-78.2 Blank)	2-78.1 (2-78.2 Blank)
2-79 and 2-80	2-79 and 2-80
None	2-80.1 and 2-80.2
2-81 and 2-82	2-81 and 2-82
2-82.1 (2-82.2 Blank)	2-82.1 (2-82.2 Blank)
2-83 through 2-86	2-83 through 2-86
None	2-86.1 and 2-86.2
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None	2-94.1 and 2-94.2
2-95 and 2-96	2-95 and 2-96
2-96.1 through 2-96.5	2-96.1 through 2-96.5 (2-96.6 Blank)
3-1 through 3-4	3-1 through 3-4
None	3-4.1 through 3-4.3 (3-4.4 Blank)

Remove pages	*Insert pages*
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3-173 and 3-174	3-173 and 3-174
None	3-174.1 (3-174.2 Blank)
3-177 through 3-186	3-177 through 3-186
3-191 and 3-192	3-191 and 3-192
None	3-192.1 (3-192.2 Blank)
3-193 and 3-194	3-193 and 3-194
3-197 and 3-198	3-197 and 3-198
None	3-198.1 (3-198.2 Blank)
3-199 through 3-202	3-199 through 3-202
None	3-202.1 and 3-202.2
3-203 and 3-204	3-203 and 3-204
3-204.1	3-204.1 (3-204.2 Blank)
3-205 through 3-218	3-205 through 3-218
3-221 and 3-222	3-221 and 3-222
3-225 and 3-226	3-225 and 3-226
3-229 and 3-230	3-229 and 3-230
3-233 through 3-240	3-233 through 3-240
None	3-240.1 (3-240.2 Blank)
3-241 through 3-249	3-241 through 3-250
None	A-1 (A-2 Blank)
Index 1 through Index 16	Index 1 through Index 17

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Chief of Staff

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Distribution:
To be distributed in accordance with DA Form 12-37, Direct and General Support Maintenance requirements for Combat Vehicles.

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *30 December 1977*

Direct Support and General Support Maintenance Manual For ENGINE WITH CONTAINER: TURBOSUPERCHARGED, DIESEL, FUEL INJECTION, 90-DEGREE "V" TYPE, AIR-COOLED, 12 — CYLINDER, ASSEMBLY; MODELS AVDS-1790-2C, 2815-00-410-1203, AVDS-1790-2D, 2815-00-410-1204 AND AVDS-1790-2DR, 2815-00-124-5387

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Remove pages	*Insert pages*
Delete warning on page 2 of cover	Warning (a)
i and ii	i and ii
1-1 through 1-18	1-1 through 1-24
2-1 through 2-10	2-1 through 2-10
None	2-10.1 through 2-10.6
2-15 through 2-18	2-15 through 2-18
None	2-18.1
2-33 and 2-34	2-33 and 2-34
None	2-34.1 and 2-34.2
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None	2-70.1 through 2-70.12
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None	2-78.1
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None	2-82.1
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None	2-96.1 through 2-96.5
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None	3-34.1 through 3-34.4
3-37 and 3-38	3-37 and 3-38
3-41 through 3-50	3-41 through 3-50
None	3-50.1 and 3-50.2
3-63 through 3-70	3-63 through 3-70

Remove pages	*Insert pages*
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None	3-96.1 through 3-96.4
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3-191 through 3-204	3-191 through 3-204
None	3-204.1
3-221 through 3-246	3-221 through 3-249
I-1 through I-15	I-1 through I-16
Authentication	Authentication
Covers 3 and 4	Covers 3 and 4

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By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

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Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-37, Direct and General Support maintenance requirements for Recovery Vehicles, Medium, M88A1, 105mm, M60, M60A1, 105mm, M60A1E3, 152mm, M60A2; Combat Engineer, Full Track, M728, Tank, Bridge Launcher, AVLB; Tank Combat Full Tracked, 90MM, M48A3, 105MM Gun, M60A1 (RISE) 105MM Gun, M48A5.

TECHNICAL MANUAL
No. 9-2815-220-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 20 December 1975

Direct Support and General Support Maintenance Manual For ENGINE WITH CONTAINER: TURBOSUPERCHARGED, DIESEL, FUEL INJECTION, 90-DEGREE "V" TYPE, AIR-COOLED, 12 — CYLINDER, ASSEMBLY; MODELS AVDS-1790-2C, (NSN 2815-00-410-1203), AVDS-1790-2D, (NSN 2815-00-410-1204) AVDS-1790-2DR, (NSN 2815-00-124-5387) MODELS AVDS-1790-2CA (NSN 2815-01-149-1353) AND AVDS-1790-2DA

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Tank-Automotive Materiel Readiness Command, ATTN: DRSTA-MB, Warren, Michigan 48090. A reply will be furnished to you.

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This technical manual contains instructions for Direct Support and General Support of the 12-cylinder, Model AVDS-1790-2C engine (figs. 1-1 through 1-4), Model AVDS-1790-2D engine (figs. 1-4 through 1-7), Model AVDS-1790-2DR engine (figs. 1-7.1 through 1-7.4), Model AVDS-1790-2CA (figs. 1-7.5 through 1-7.7) and Model AVDS-1790-2DA (figs. 1-7.7 through 1-7.9). Included are descriptions of and procedures for removal of engine accessories and components, troubleshooting, disassembly, inspection (including engine repair standards) repair, reassembly, and testing of the engines. These descriptions and procedures are identical for each model except where otherwise indicated. Added paragraphs and figures are indicated by decimal point additions. Added paragraphs appear as 2-21.1, and added figures appear as 1-7.1.

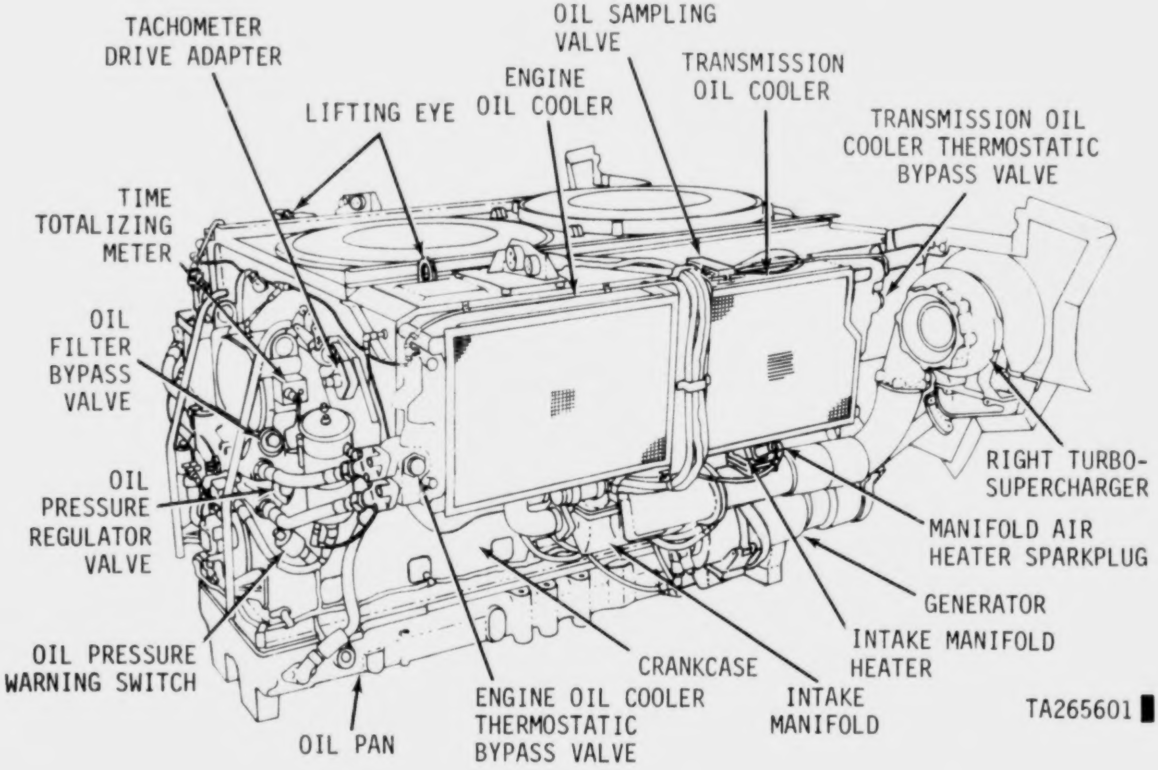

TACHOMETER DRIVE ADAPTER
OIL SAMPLING VALVE
ENGINE OIL COOLER
TRANSMISSION OIL COOLER
LIFTING EYE
TRANSMISSION OIL COOLER THERMOSTATIC BYPASS VALVE
TIME TOTALIZING METER
OIL FILTER BYPASS VALVE
RIGHT TURBO-SUPERCHARGER
OIL PRESSURE REGULATOR VALVE
MANIFOLD AIR HEATER SPARKPLUG
GENERATOR
INTAKE MANIFOLD HEATER
OIL PRESSURE WARNING SWITCH
CRANKCASE
ENGINE OIL COOLER THERMOSTATIC BYPASS VALVE
INTAKE MANIFOLD
OIL PAN
TA265601

Figure 1-1. AVDS-1790-2C engine assembly — right front view.

b. Appendix A contains a list of current references, including supply manuals, forms, technical manuals, and other available publications applicable to the materiel.

c. TM 9-2815-220-34P contains an illustrated list of all repair parts and special tools stocked for Direct and General Support maintenance of the engine.

1-2. Forms and Records

a. The prescribed maintenance responsibilities are designated in the appropriate columns of the maintenance allocation charts located in the pertinent vehicle organizational manual.

b. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

1-3. Reporting of Errors

(Deleted)

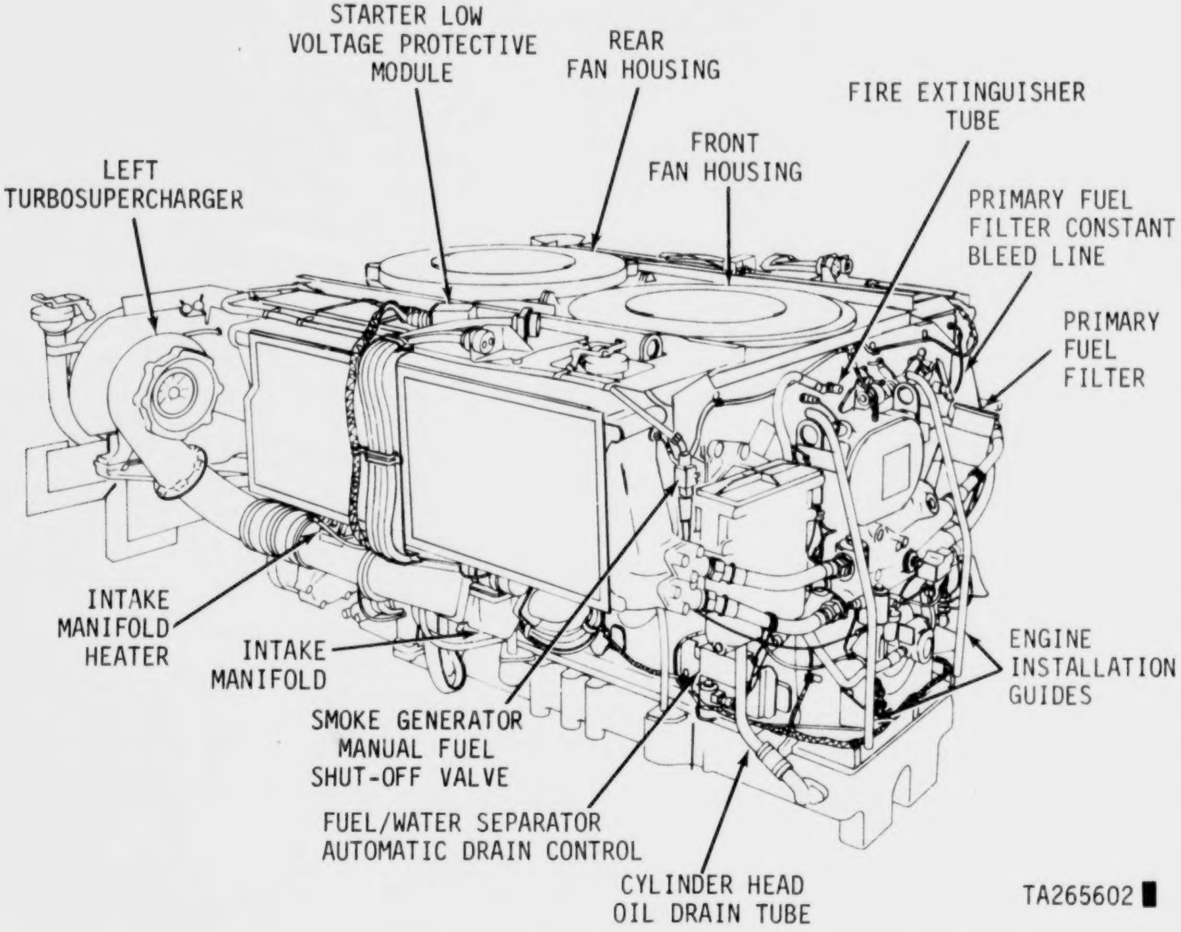

STARTER LOW VOLTAGE PROTECTIVE MODULE
REAR FAN HOUSING
FIRE EXTINGUISHER TUBE
FRONT FAN HOUSING
LEFT TURBOSUPERCHARGER
PRIMARY FUEL FILTER CONSTANT BLEED LINE
PRIMARY FUEL FILTER
INTAKE MANIFOLD HEATER
INTAKE MANIFOLD
ENGINE INSTALLATION GUIDES
SMOKE GENERATOR MANUAL FUEL SHUT-OFF VALVE
FUEL/WATER SEPARATOR AUTOMATIC DRAIN CONTROL
CYLINDER HEAD OIL DRAIN TUBE
TA265602

Figure 1-2. AVDS-1790-2C engine assembly – left front view.

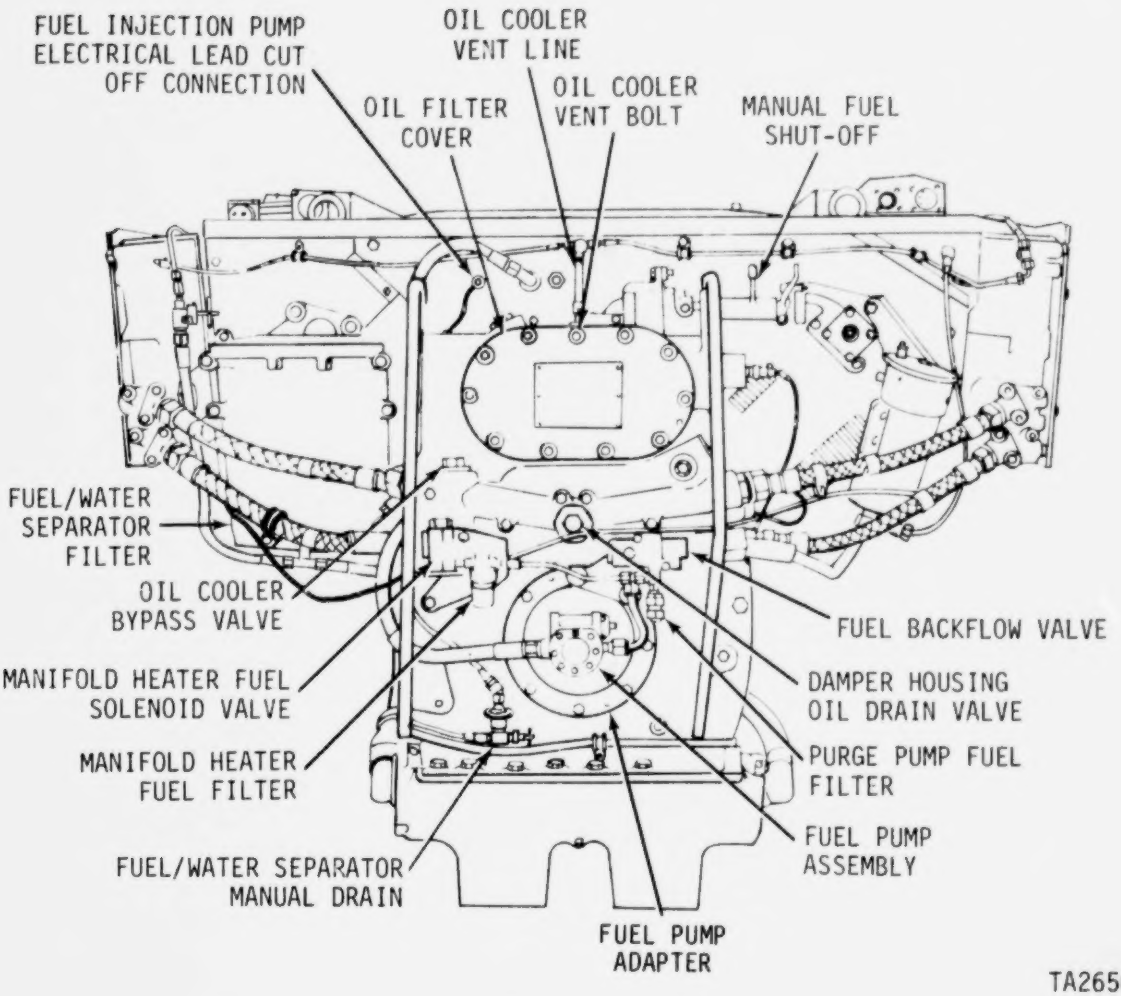
1-4. Differences Between Engine Models

a. The Model AVDS-1790-2C engine is equipped with a 28 volt, 650 ampere, oil cooled dc generator (fig. 1-1).

b. The Model AVDS-1790-2D engine is equipped with a 28 volt, 300 ampere, air cooled dc generator (fig. 1-5).

c. The Model AVDS-1790-2DR engine is similar to Model AVDS-1790-2D except that it has a power take-off unit mounted on the damper housing, and a solenoid controlled throttle linkage designed to maintain a minimum engine speed for operation of the power take-off unit (fig. 1-7.1). The turbosuperchargers are located approximately 2.50 inches inboard which necessitated reindexing the turbosupercharger outlets to accommodate the new location (figs. 1-7.1 and 1-7.2). The flywheel has an internal ring gear for driving the transmission and is mounted to the crankshaft through an adapter (fig. 1-7.4). The transmission adapter (housing) serves as a spacer for attaching the transmission to the engine. Fuel injection pump overflow fuel is routed back through the front engine shroud, and the fuel return tube cross at the rear of the engine is blocked. This model is not equipped with engine installation guides or wiring harness.

d. The Model AVDS-1790-2CA is similar to the Model AVDS-1790-2C except it is equipped with a clean air package (fig. 1-7.5). Description and repair procedures for the Model AVDS-1790-2CA are covered in Chapter 4 of this manual.


FUEL INJECTION PUMP ELECTRICAL LEAD CUT OFF CONNECTION
OIL COOLER VENT LINE
OIL FILTER COVER
OIL COOLER VENT BOLT
MANUAL FUEL SHUT-OFF
FUEL/WATER SEPARATOR FILTER
OIL COOLER BYPASS VALVE
FUEL BACKFLOW VALVE
MANIFOLD HEATER FUEL SOLENOID VALVE
DAMPER HOUSING OIL DRAIN VALVE
MANIFOLD HEATER FUEL FILTER
PURGE PUMP FUEL FILTER
FUEL PUMP ASSEMBLY
FUEL/WATER SEPARATOR MANUAL DRAIN
FUEL PUMP ADAPTER

TA265603

Figure 1-3. AVDS-1790-2C engine assembly — front view.

e. The Model AVDS-1790-2DA is similar to the Model AVDS-1790-2D except it is equipped with a clean air package (fig. 1-7.8). Description and repair procedures for the Model AVDS-1790-2DA are covered in Chapter 4 of this manual.

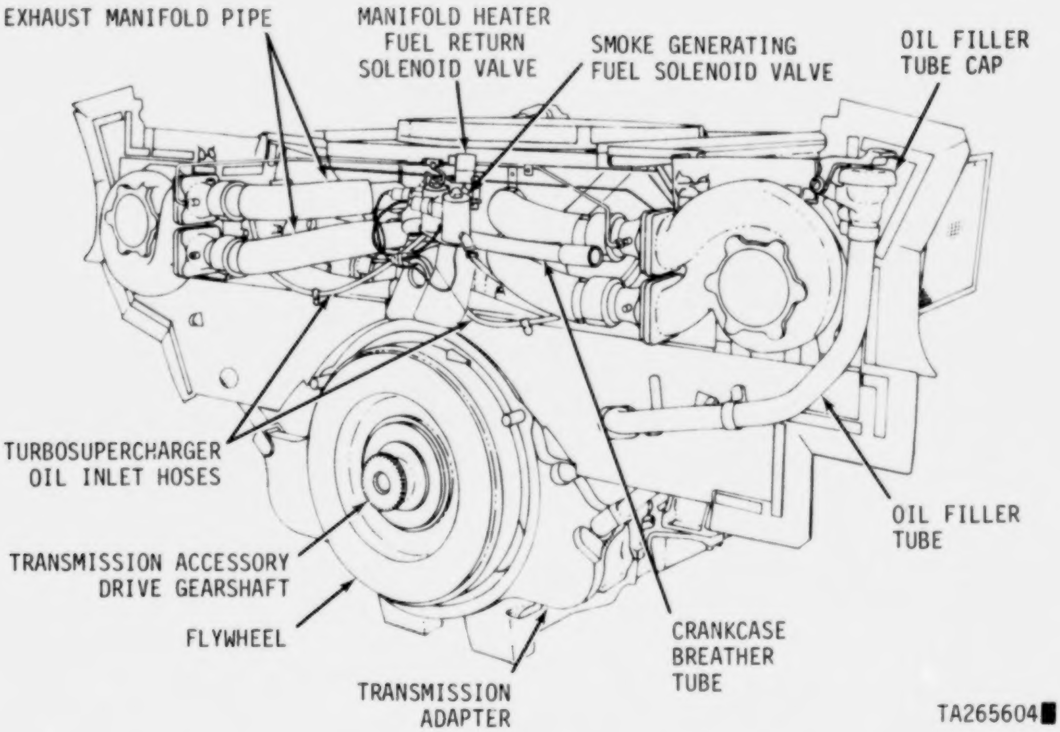

EXHAUST MANIFOLD PIPE
MANIFOLD HEATER FUEL RETURN SOLENOID VALVE
SMOKE GENERATING FUEL SOLENOID VALVE
OIL FILLER TUBE CAP
TURBOSUPERCHARGER OIL INLET HOSES
TRANSMISSION ACCESSORY DRIVE GEARSHAFT
FLYWHEEL
TRANSMISSION ADAPTER
CRANKCASE BREATHER TUBE
OIL FILLER TUBE
TA265604

Figure 1-4. AVDS-1790-2C and AVDS-1790-2D engine assembly – rear view.

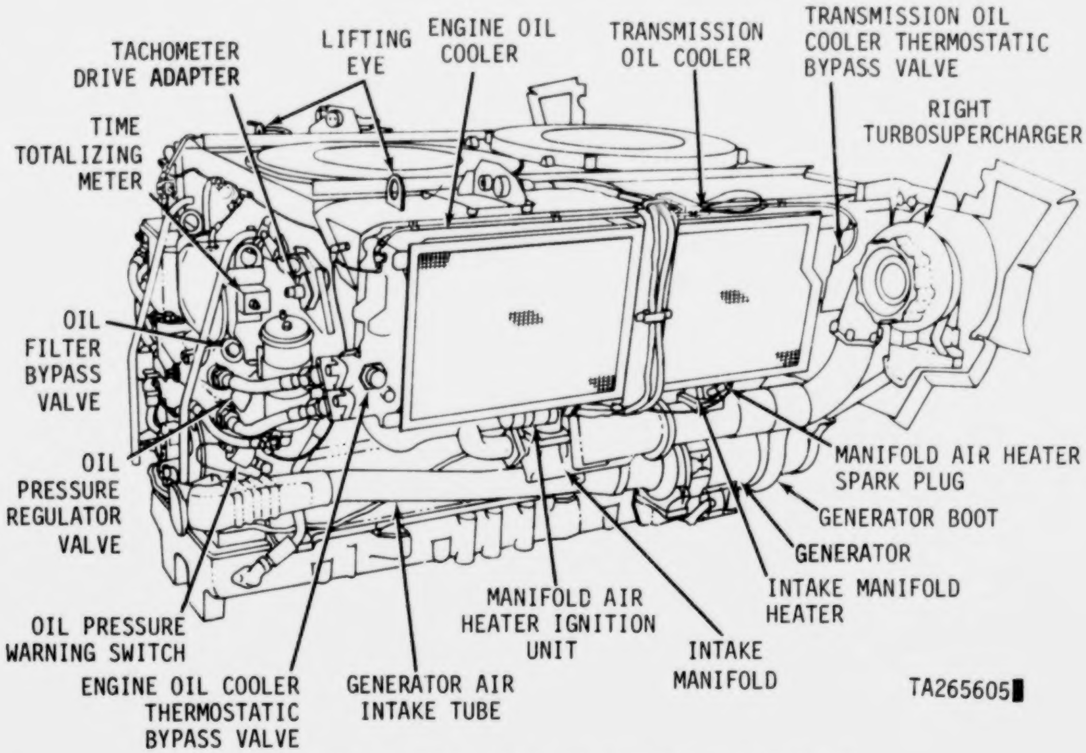

TACHOMETER DRIVE ADAPTER
LIFTING EYE
ENGINE OIL COOLER
TRANSMISSION OIL COOLER
TRANSMISSION OIL COOLER THERMOSTATIC BYPASS VALVE
RIGHT TURBOSUPERCHARGER
TIME TOTALIZING METER
OIL FILTER BYPASS VALVE
OIL PRESSURE REGULATOR VALVE
MANIFOLD AIR HEATER SPARK PLUG
GENERATOR BOOT
GENERATOR
INTAKE MANIFOLD HEATER
MANIFOLD AIR HEATER IGNITION UNIT
OIL PRESSURE WARNING SWITCH
ENGINE OIL COOLER THERMOSTATIC BYPASS VALVE
GENERATOR AIR INTAKE TUBE
INTAKE MANIFOLD
TA265605

Figure 1-5. AVDS-1790-2D engine assembly – right front view.

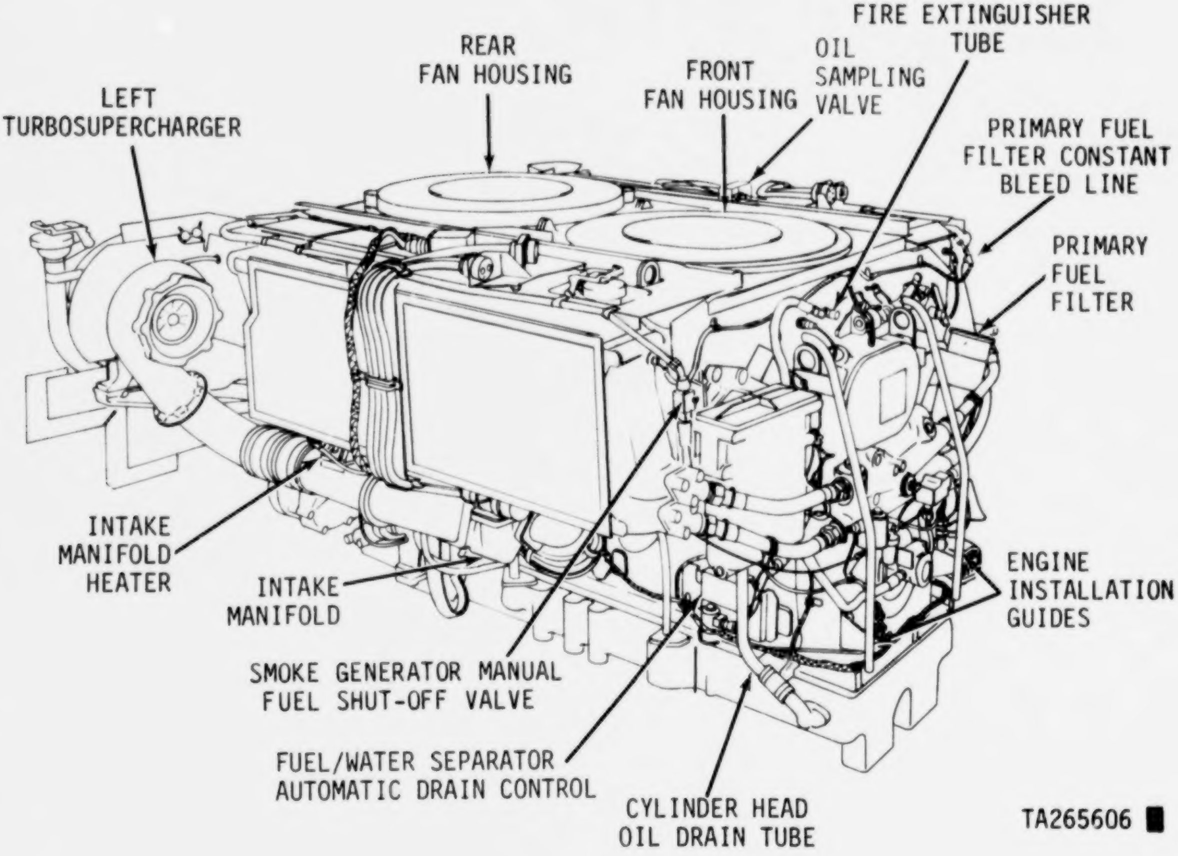

REAR FAN HOUSING
FRONT FAN HOUSING
OIL SAMPLING VALVE
FIRE EXTINGUISHER TUBE
LEFT TURBOSUPERCHARGER
PRIMARY FUEL FILTER CONSTANT BLEED LINE
PRIMARY FUEL FILTER
INTAKE MANIFOLD HEATER
INTAKE MANIFOLD
ENGINE INSTALLATION GUIDES
SMOKE GENERATOR MANUAL FUEL SHUT-OFF VALVE
FUEL/WATER SEPARATOR AUTOMATIC DRAIN CONTROL
CYLINDER HEAD OIL DRAIN TUBE
TA265606

Figure 1-6. AVDS-1790-2D engine assembly — left front view.

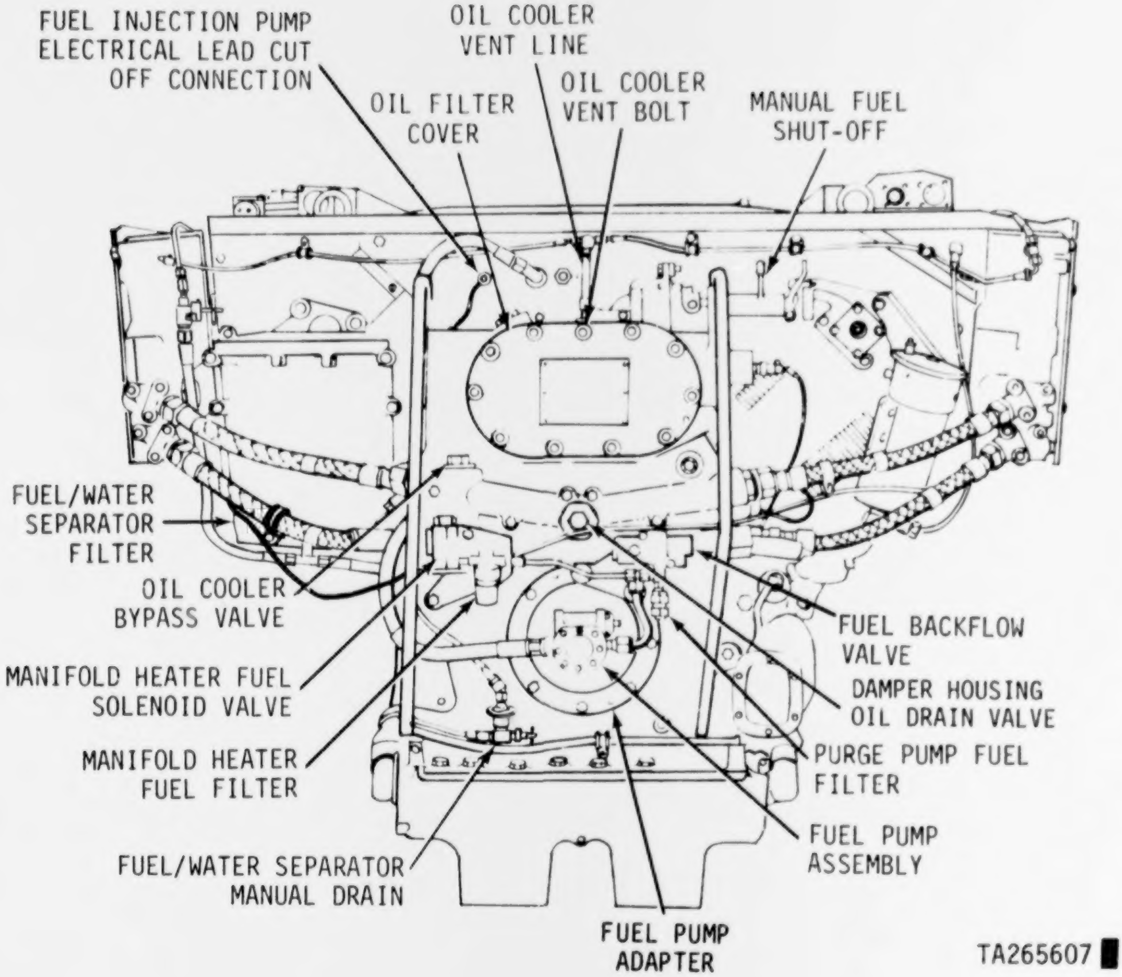

FUEL INJECTION PUMP ELECTRICAL LEAD CUT OFF CONNECTION
OIL COOLER VENT LINE
OIL FILTER COVER
OIL COOLER VENT BOLT
MANUAL FUEL SHUT-OFF
FUEL/WATER SEPARATOR FILTER
OIL COOLER BYPASS VALVE
MANIFOLD HEATER FUEL SOLENOID VALVE
MANIFOLD HEATER FUEL FILTER
FUEL/WATER SEPARATOR MANUAL DRAIN
FUEL PUMP ADAPTER
FUEL BACKFLOW VALVE
DAMPER HOUSING OIL DRAIN VALVE
PURGE PUMP FUEL FILTER
FUEL PUMP ASSEMBLY
TA265607

Figure 1-7. AVDS-1790-2D engine assembly — front view.

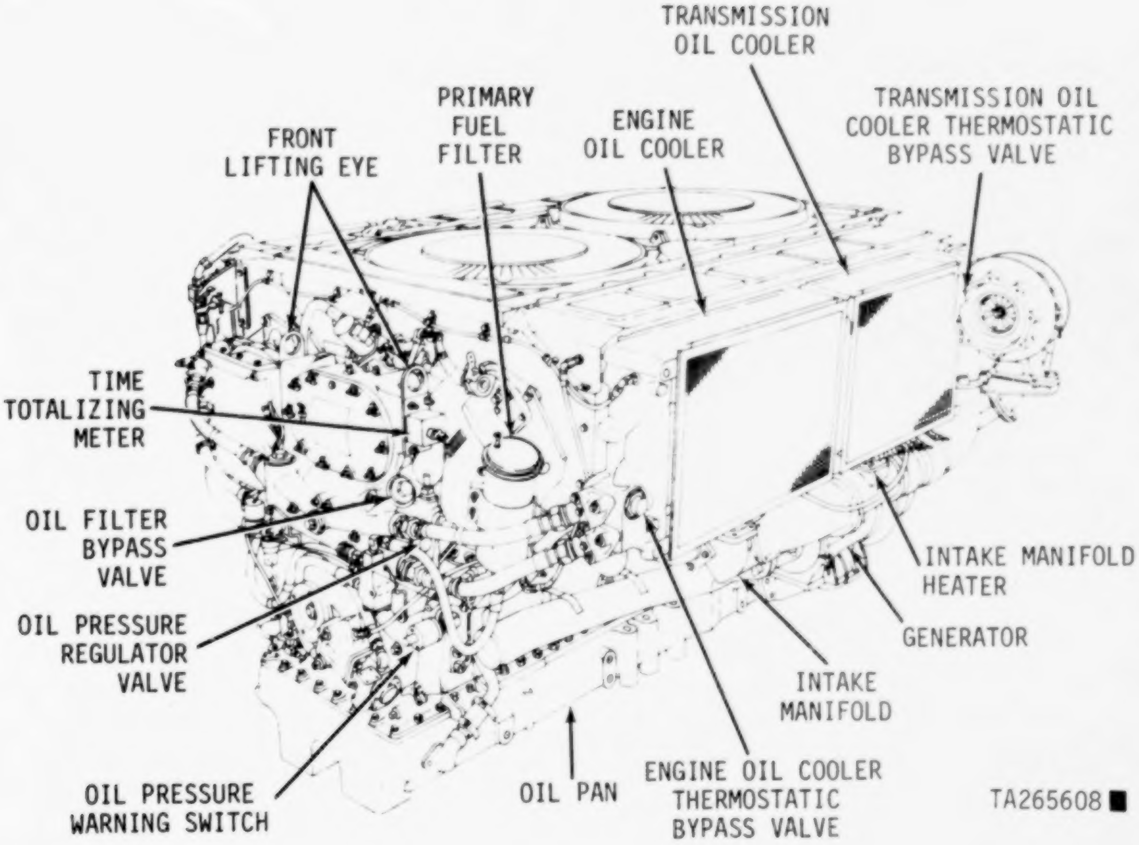

TRANSMISSION OIL COOLER
PRIMARY FUEL FILTER
ENGINE OIL COOLER
TRANSMISSION OIL COOLER THERMOSTATIC BYPASS VALVE
FRONT LIFTING EYE
TIME TOTALIZING METER
OIL FILTER BYPASS VALVE
OIL PRESSURE REGULATOR VALVE
OIL PRESSURE WARNING SWITCH
OIL PAN
ENGINE OIL COOLER THERMOSTATIC BYPASS VALVE
INTAKE MANIFOLD
GENERATOR
INTAKE MANIFOLD HEATER
TA265608

Figure 1-7.1. AVDS-1790-2DR engine assembly – right front view.

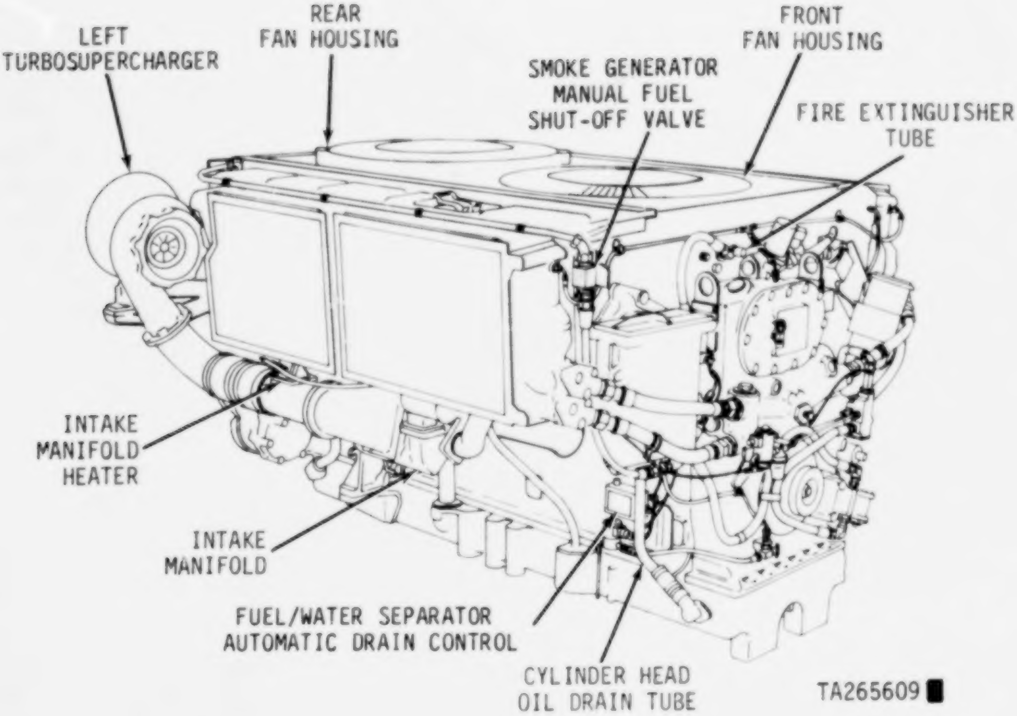

LEFT TURBOSUPERCHARGER
REAR FAN HOUSING
SMOKE GENERATOR MANUAL FUEL SHUT-OFF VALVE
FRONT FAN HOUSING
FIRE EXTINGUISHER TUBE
INTAKE MANIFOLD HEATER
INTAKE MANIFOLD
FUEL/WATER SEPARATOR AUTOMATIC DRAIN CONTROL
CYLINDER HEAD OIL DRAIN TUBE
TA265609

Figure 1-7.2. AVDS-1790-2DR engine assembly – left front view.

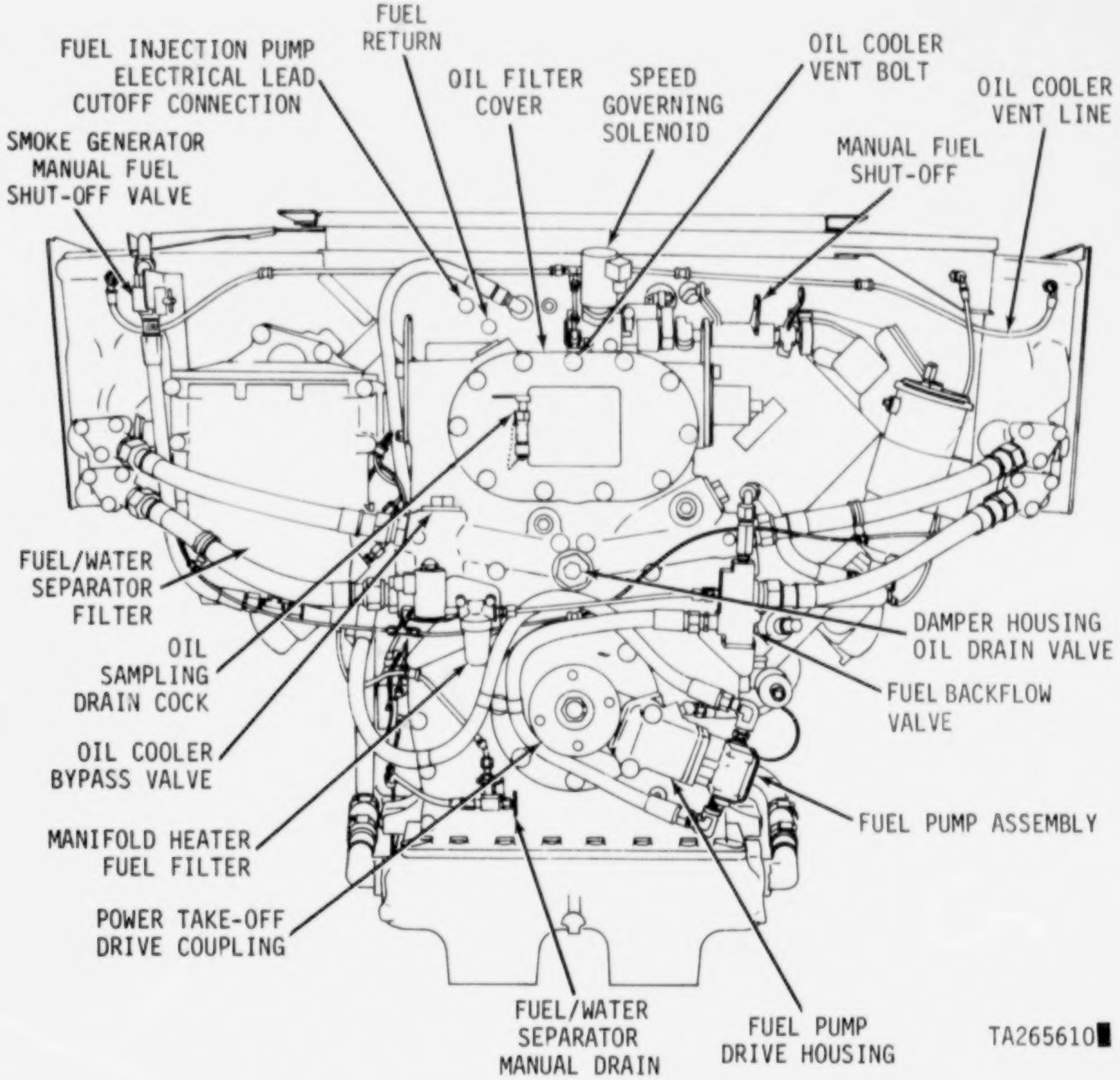

FUEL INJECTION PUMP ELECTRICAL LEAD CUTOFF CONNECTION
FUEL RETURN
OIL FILTER COVER
SPEED GOVERNING SOLENOID
OIL COOLER VENT BOLT
OIL COOLER VENT LINE
SMOKE GENERATOR MANUAL FUEL SHUT-OFF VALVE
MANUAL FUEL SHUT-OFF
FUEL/WATER SEPARATOR FILTER
OIL SAMPLING DRAIN COCK
OIL COOLER BYPASS VALVE
MANIFOLD HEATER FUEL FILTER
POWER TAKE-OFF DRIVE COUPLING
DAMPER HOUSING OIL DRAIN VALVE
FUEL BACKFLOW VALVE
FUEL PUMP ASSEMBLY
FUEL/WATER SEPARATOR MANUAL DRAIN
FUEL PUMP DRIVE HOUSING
TA265610

Figure 1-7.3. AVDS-1790-2DR engine assembly – front view.

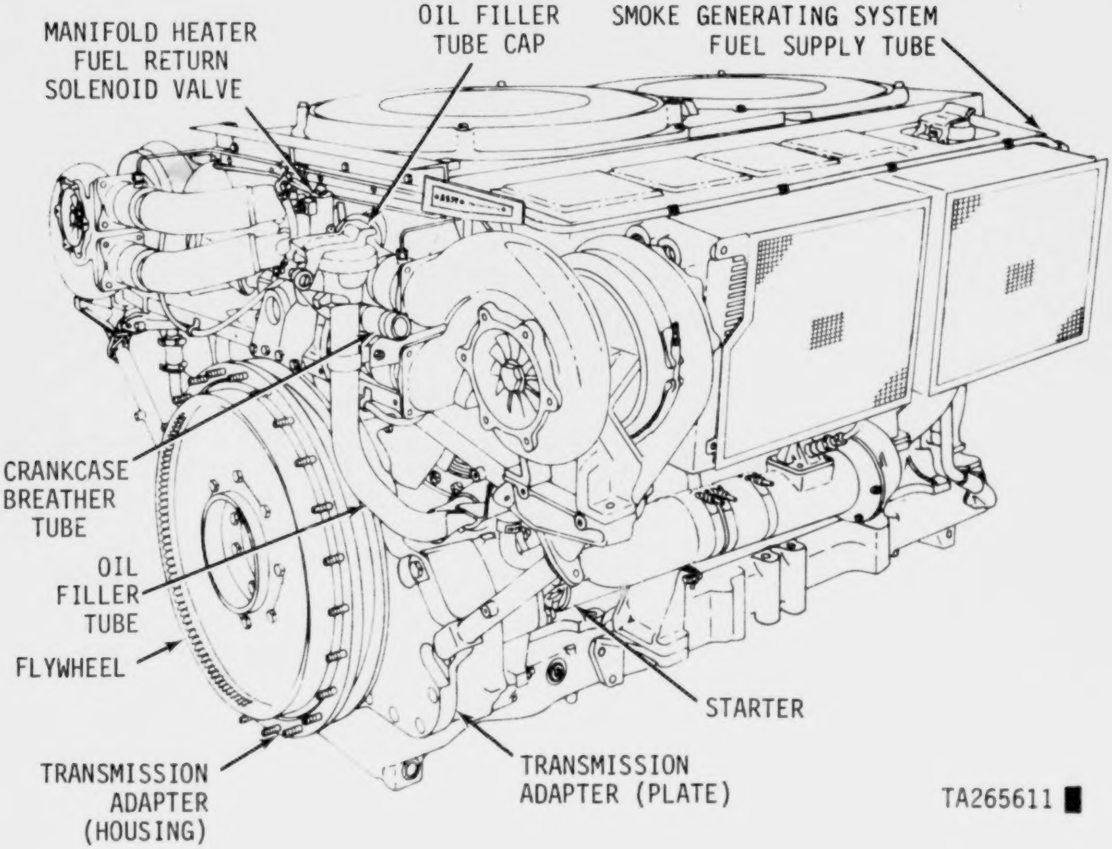

MANIFOLD HEATER FUEL RETURN SOLENOID VALVE
OIL FILLER TUBE CAP
SMOKE GENERATING SYSTEM FUEL SUPPLY TUBE
CRANKCASE BREATHER TUBE
OIL FILLER TUBE
FLYWHEEL
STARTER
TRANSMISSION ADAPTER (HOUSING)
TRANSMISSION ADAPTER (PLATE)
TA265611

Figure 1-7.4. AVDS-1790-2DR engine assembly – left rear view.

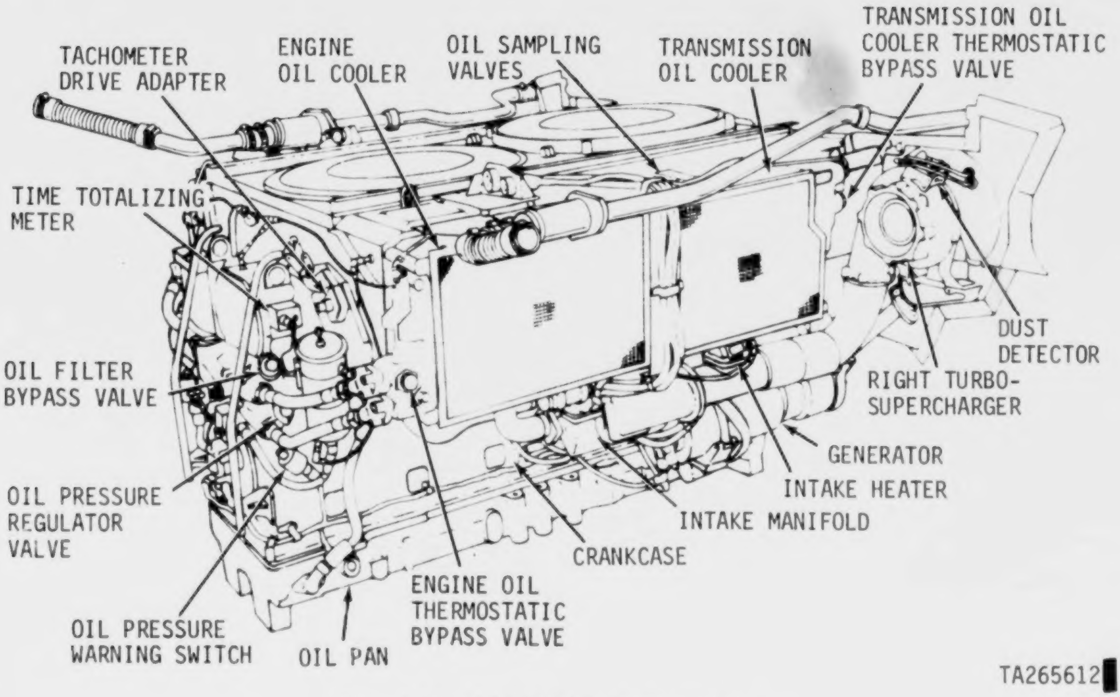

TACHOMETER DRIVE ADAPTER
ENGINE OIL COOLER
OIL SAMPLING VALVES
TRANSMISSION OIL COOLER
TRANSMISSION OIL COOLER THERMOSTATIC BYPASS VALVE
TIME TOTALIZING METER
DUST DETECTOR
RIGHT TURBO-SUPERCHARGER
OIL FILTER BYPASS VALVE
GENERATOR
INTAKE HEATER
OIL PRESSURE REGULATOR VALVE
INTAKE MANIFOLD
CRANKCASE
ENGINE OIL THERMOSTATIC BYPASS VALVE
OIL PRESSURE WARNING SWITCH
OIL PAN
TA265612

Figure 1-7.5. AVDS-1790-2CA engine assembly - right front view.

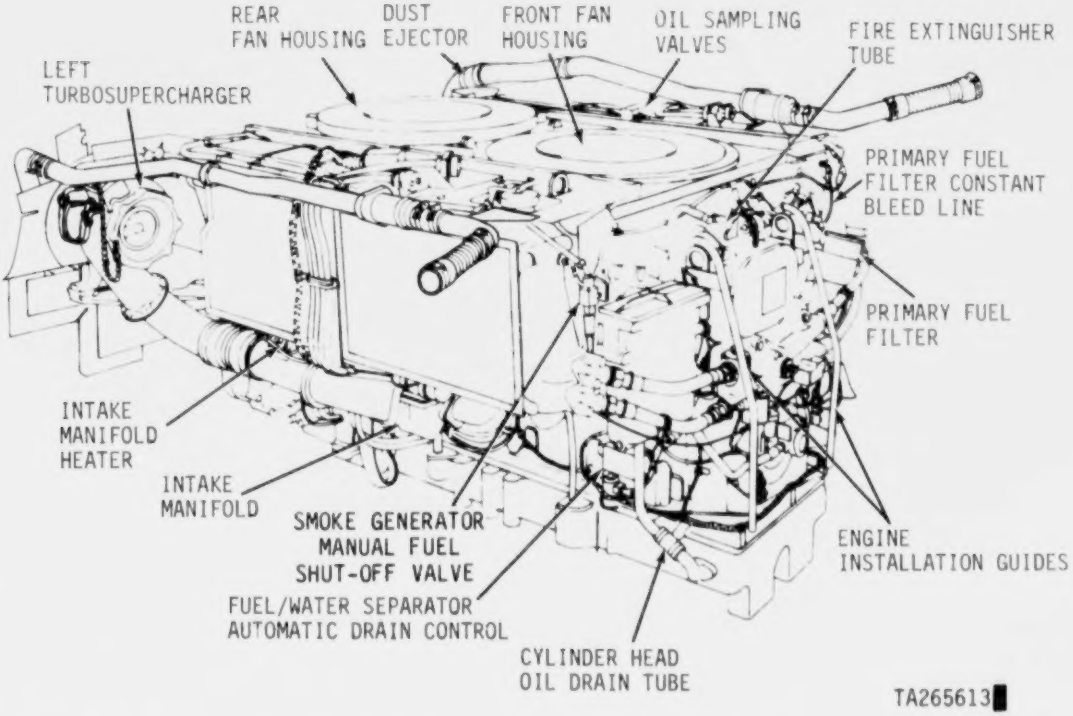

REAR FAN HOUSING
DUST EJECTOR
FRONT FAN HOUSING
OIL SAMPLING VALVES
FIRE EXTINGUISHER TUBE
LEFT TURBOSUPERCHARGER
PRIMARY FUEL FILTER CONSTANT BLEED LINE
PRIMARY FUEL FILTER
INTAKE MANIFOLD HEATER
INTAKE MANIFOLD
SMOKE GENERATOR MANUAL FUEL SHUT-OFF VALVE
ENGINE INSTALLATION GUIDES
FUEL/WATER SEPARATOR AUTOMATIC DRAIN CONTROL
CYLINDER HEAD OIL DRAIN TUBE
TA265613

Figure 1-7.6. AVDS-1790-2CA engine assembly - left front view.

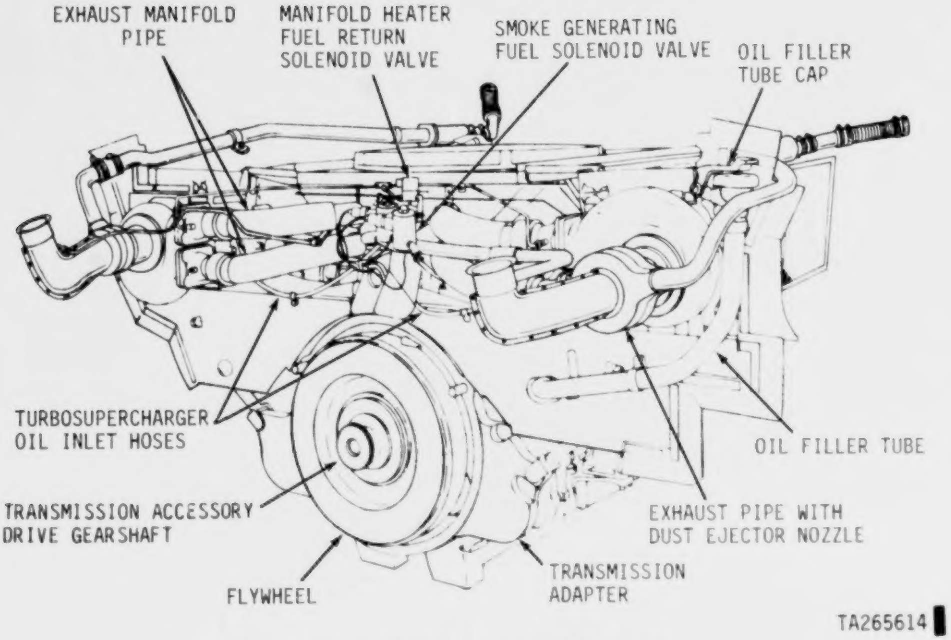

EXHAUST MANIFOLD PIPE
MANIFOLD HEATER FUEL RETURN SOLENOID VALVE
SMOKE GENERATING FUEL SOLENOID VALVE
OIL FILLER TUBE CAP
TURBOSUPERCHARGER OIL INLET HOSES
OIL FILLER TUBE
TRANSMISSION ACCESSORY DRIVE GEARSHAFT
EXHAUST PIPE WITH DUST EJECTOR NOZZLE
FLYWHEEL
TRANSMISSION ADAPTER
TA265614

Figure 1-7.7. AVDS-1790-2CA and AVDS-1790-2DA engine assemblies - rear view.

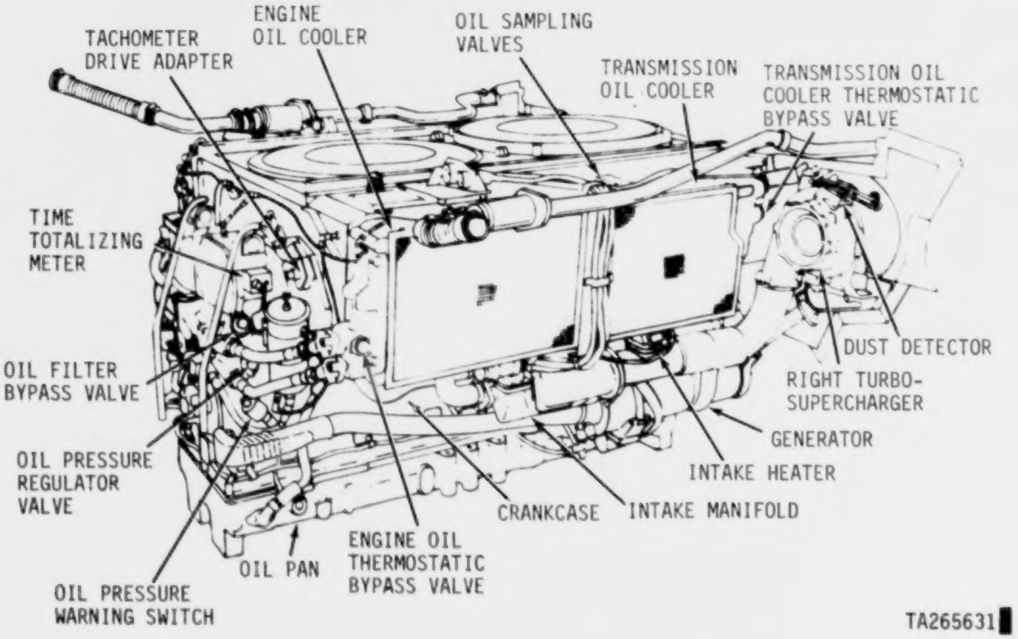

TACHOMETER DRIVE ADAPTER
ENGINE OIL COOLER
OIL SAMPLING VALVES
TRANSMISSION OIL COOLER
TRANSMISSION OIL COOLER THERMOSTATIC BYPASS VALVE
TIME TOTALIZING METER
DUST DETECTOR
OIL FILTER BYPASS VALVE
RIGHT TURBO-SUPERCHARGER
GENERATOR
OIL PRESSURE REGULATOR VALVE
INTAKE HEATER
CRANKCASE
INTAKE MANIFOLD
ENGINE OIL THERMOSTATIC BYPASS VALVE
OIL PAN
OIL PRESSURE WARNING SWITCH
TA265631

Figure 1-7.8. AVDS-1790-2DA engine assembly - right front view.

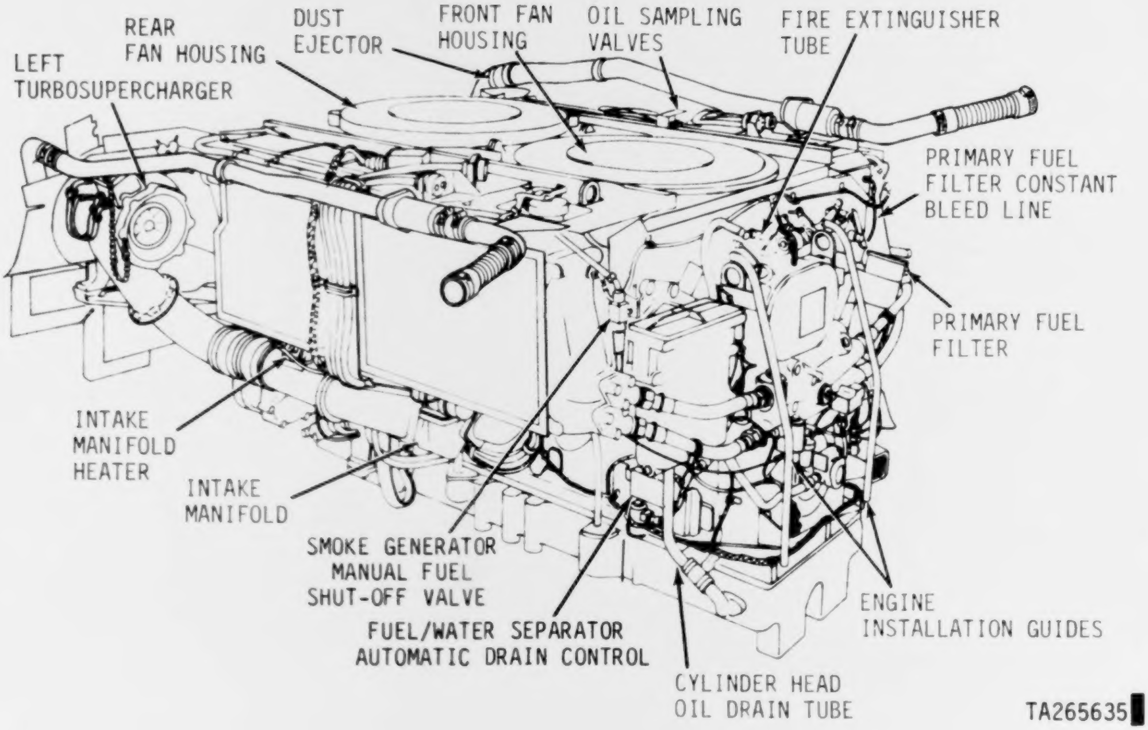

LEFT TURBOSUPERCHARGER
REAR FAN HOUSING
DUST EJECTOR
FRONT FAN HOUSING
OIL SAMPLING VALVES
FIRE EXTINGUISHER TUBE
PRIMARY FUEL FILTER CONSTANT BLEED LINE
PRIMARY FUEL FILTER
INTAKE MANIFOLD HEATER
INTAKE MANIFOLD
SMOKE GENERATOR MANUAL FUEL SHUT-OFF VALVE
FUEL/WATER SEPARATOR AUTOMATIC DRAIN CONTROL
CYLINDER HEAD OIL DRAIN TUBE
ENGINE INSTALLATION GUIDES
TA265635

Figure 1-7.9. AVDS-1790-2DA engine assembly - left front view.

Section II. DESCRIPTION

1-5. Location of Engine Components

a. In this manual the terms defined in *b* through *e* below will be used to identify the location of parts and assemblies on the engine.

b. The ends of the engine will be called the "damper end" or "front" and the "flywheel end" or "rear."

c. As viewed from the front end toward the rear, the side to the right will be called the "right side" and the side to the left will be called the "left side." Beginning at the front, the right bank of cylinders is numbered 1R through 6R and the left bank of cylinders is numbered 1L through 6L.

d. Starting from the front, the main bearings are numbered 1 through 7.

e. The cylinders, pistons, connecting rods, and connecting rod bearings are numbered with their respective cylinder number locations.

1-6. General Description

NOTE

For instructional purposes the figure references shown in this section are for the AVDS-1790-2C model engine except when otherwise indicated.

a. The engine Models AVDS-1790-2C (figs. 1-1 through 1-4), AVDS-1790-2D (figs. 1-4 through 1-7), AVDS-1790-2DR (figs. 1-7.1 through 1-7.4), AVDS-1790-2CA (figs. 1-7.5 through 1-7.7) and AVDS-1790-2DA (figs. 1-7.7 through 1-7.9) are12-cylinder, 90 degree, V-type, 4 cycle, air cooled turbosupercharged diesel engines. The cylinder assemblies are individually replaceable units with overhead valves and valve rocker assemblies in the head. The cylinders are arranged in two banks of six cylinders each. Each bank of cylinders has an overhead camshaft arrangement to actuate the valves of each cylinder.

b. The engine features a fuel injection system and a turbosupercharged air induction system which obtains optimum engine performance. The fuel injection system has a fuel injection metering pump which supplies metered fuel to individual cylinders through fuel injector nozzles. The fuel supply pump assembly (fig. 1-3) located at the front of the engine draws fuel through the primary and secondary fuel systems from the vehicle fuel tanks and delivers it to the injection pump. A turbosupercharger assembly (figs. 1-1 and 1-2) is located on each side of the engine at the rear. The turbosuperchargers are exhaust-gas driven and increase the air flow pressure entering the air intake manifolds (figs. 1-1 and 1-2).

c. The Model AVDS-1790-2C and Model AVDS-1790-2CA engines are equipped with a 28-volt oil cooled dc generator (fig. 1-1) capable of 650 ampere output over the engine operating range. The generator produces an alternating current which is rectified within the unit to give a direct current to the output terminals.

d. The Models AVDS-1790-2D, AVDS-1790-2DR and AVDS-1790-2DA engines are equipped with a 28 volt, 300 ampere air-cooled direct current generator (figs 1-5, 1-7.1, and 1-7.8). A blower motor mounted on the generator draws cooling air from the crew compartment through the air intake tube which extends along the crankcase below the intake manifold on the right side of the engine. The generator air exhaust tube elbow is connected to the rear of the engine shroud. Generator outlet air is exhausted through the rear cooling fan vane.

e. The engines have a 24-volt solenoid operated starter (fig. 1-2). A low voltage sensing module prevents starter activation with improperly charged batteries.

f. The engines are lubricated by a forced feed system. The system consists of four circuits; i.e., the scavenge circuit, the main or pressure oil circuit, the leveling circuit, and the make up circuit. These circuits are operated independently by one oil pump which consists of four separate sections.

g. The engines are equipped with two intake manifold heaters (figs. 1-1 and 1-2) which are installed in the air intake systems between the intake manifold elbows and the turbosuperchargers. The heaters, when operated, preheat the air entering the cylinders to facilitate cold weather starting and cold weather idle operation.

h. The engine crankcase is vented by an enclosed crankcase breather system which is vented through the crankcase breather tube (fig. 1-4) at the left turbosupercharger exhaust pipe.

i. The engine primary and fuel/water separator type secondary fuel filters (figs. 1-2 and 1-3) both have top mounted bleeder valves to assist in the removal of air from the fuel system. Water is removed automatically by a constant bleed orifice in the primary fuel filter and an automatic water drain in the fuel/water separator filter.

1-7. Accessories

Refer to appendix A for information on engine accessories.

1-8. Crankcase

The crankcase (fig. 1-1) is a one-piece aluminum casting with forged aluminum main bearing caps. The bearing caps function as an integral part of the crankcase. Each cap is secured on studs with four slotted nuts. Two through bolts clamp the main bearing cap in the tunnel slot of the crankcase. With this type of crankcase and bearing cap construction, uniform load distribution in the bearing area is obtained making possible uniform distribution of combustion forces over the entire crankcase.

1-9. Main Bearings

The seven replaceable main bearings are the steel-backed, split type, having copper-lead alloy bearing surfaces. The center main bearing is double-flanged with bearing material to control crankshaft end play and thrust.

1-10. Crankshaft, Flywheel, and Damper

NOTE

The key numbers shown below in parentheses refer to figure 1-8.

a. Crankshaft assembly (42) is a nitrided steel forging with seven main bearing journals and six crankpins. Each crankpin accommodates two opposing connecting rod assemblies (46). Flanges are provided on the crankshaft for mounting the flywheel (13) on the rear end and a torsional vibration damper (45) on the front end.

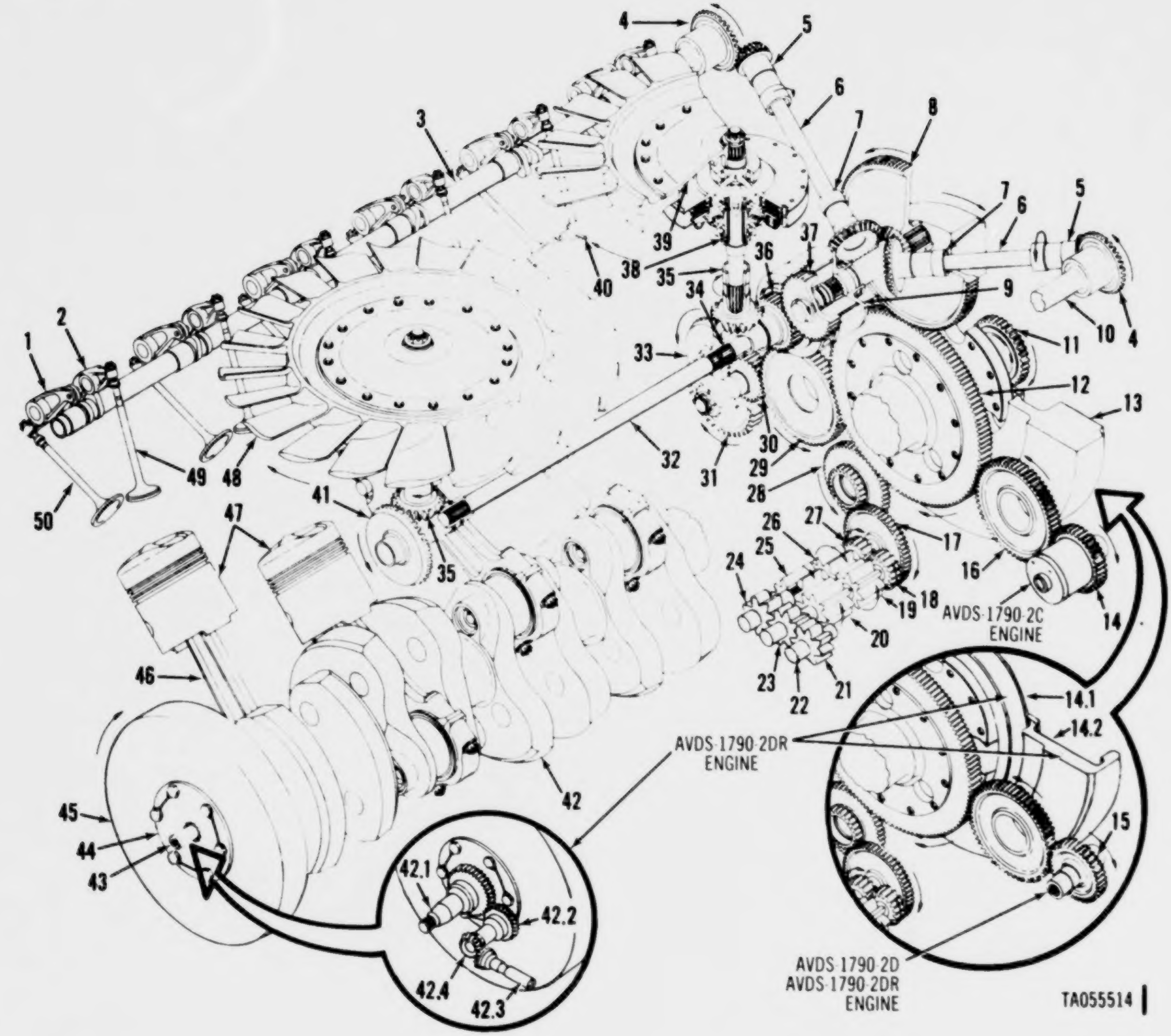
b. All crankpin bearing journals are hollow to reduce weight. Holes are drilled diagonally through each main bearing journal and extend through the crank cheek and crankpin to provide a direct passage for oil under pressure to the connecting rod and crankshaft main bearings as shown in figure 1-9.

c. The crankshaft and flywheel are statically and dynamically balanced.

d. The torsional vibration damper (45) is a precision viscous type and is replaceable only as an assembly.

1-11. Connecting Rods and Bearings

The connecting rod assemblies (46, fig. 1-8) are tapered, I-beam section steel forgings. A bronze-



1 Intake valve rocker arm assembly
2 Exhaust valve rocker arm assembly
3 Left camshaft assembly
4 Camshaft driven gear
5 Camshaft drive gearshaft
6 Camshaft drive shaft
7 Camshaft drive bevel gearshaft
8 Accessory drive gearshaft assembly
9 Fuel injection pump advance assembly
10 Right camshaft assembly
11 Transmission accessory drive gearshaft
12 Accessory drive gear
13 Flywheel (Models AVDS-1790-2C and AVDS-1790-2D)
14 Generator drive gearshaft (Model AVDS-1790-2C)
14.1 Flywheel adapter (Model AVDS-1790-2DR)
14.2 Flywheel (Model AVDS-1790-2DR)
15 Generator drive gearshaft (Models AVDS-1790-2D and AVDS-1790-2DR)
16 Generator idler gear
17 Oil pump driven gear
18 Level control oil pump driven impeller
19 Pressure oil pump driven impeller
20 Scavenge oil pump driven impeller
21 Make up oil pump driven impeller
22 Make up oil pump drive shaft
23 Oil pump driven impeller shaft
24 Make up oil pump drive impeller
25 Scavenge oil pump drive impeller
26 Pressure oil pump impeller drive shaft
27 Level control oil pump drive impeller
28 Oil pump drive gear
29 Starter idler gear
30 Starter driven gearshaft
31 Starter drive gear
32 Front fan drive shaft
33 Fan drive bevel gearshaft
34 Rear fan drive shaft
35 Fan driven gearshaft
36 Fuel injection pump drive gearshaft
37 Fuel injection pump driven shaft gear
38 Fan drive clutch assembly
39 Cooling fan adapter
40 Rear cooling fan assembly
41 Fan drive bevel gearshaft
42 Crankshaft assembly
42.1 Power take-off gearshaft (Model AVDS-1790-2DR)
42.2 Fuel pump drive gear (Model AVDS-1790-2DR)
42.3 Fuel pump driven gear (Model AVDS-1790-2DR)
42.4 Fuel pump drive idler gear (Model AVDS-1790-2DR)
43 Fuel pump drive coupling (Models AVDS-1790-2C and AVDS-1790-2D)
44 Fuel pump drive adapter (Models AVDS-1790-2C and AVDS-1790-2D)
45 Crankshaft torsional vibration damper
46 Connecting rod assembly
47 Piston
48 Front cooling fan assembly
49 Exhaust valve
50 Intake valve

Figure 1-8. Engine major working parts.

lined, steel-backed, split bushing type bearing is pressed into the piston pin end of the rod. The replaceable precision connecting rod bearings are the steel-backed, split type having copper-lead alloy bearing surfaces.

1-12. Pistons, Pins and Rings

The pistons (47, fig. 1-8) are aluminum castings, cam ground and tapered to provide an accurate fit in the cylinders at operating temperatures. The piston dome is machined to the shape of a conical section (toridal shape) so that it tapers into the open type combustion chamber. Each piston is fitted with four rings. The top ring groove is composed of a steel insert which is an integral part of the piston. The three remaining ring grooves are machined into the aluminum piston. The upper three rings are compression rings and the bottom ring is an oil-control ring. The heavy walled, tubular, steel piston pins are full-floating in the piston and the connecting rod. The piston pin is retained in the piston by retaining rings, one at each end of the piston pin, in the piston pin bore.

1-13. Cylinders and Valves

NOTE

The key numbers shown below in parentheses refer to figure 1-8 except where otherwise indicated.

a. Each cylinder assembly is an individually replaceable unit that consists of a barrel, cooling fin muff, and a cylinder head. The cylinder barrel, dome and intake and exhaust port liners are steel. The aluminum cylinder head cooling fins are cast to the steel dome. The cooling fins for the barrel are machined into an aluminum muff and shrunk onto the steel barrel. After the cylinder barrel fins are machined, the head and barrel are electron beam welded to form a single unit. Valve guides and seats are shrunk into place in the head. A mounting flange is machined on the cylinder barrel near the base to provide an attachment of the cylinder to the crankcase. The cylinder assembly is secured to the crankcase with studs and nuts. An outer extension of the cylinder head encloses a recess or rocker box, which houses the valves, valve springs, and related parts. Rocker arm assemblies (1 and 2) are held in place by rocker shafts in the cylinder head valve rocker support cover.

b. A camshaft bearing surface is provided in each cylinder. The camshaft bearing is bored with the cylinder head valve rocker support cover in place; therefore, the covers are not interchangeable and each must remain as a part of a specific cylinder assembly. Each cylinder has replaceable camshaft bearings at the camshaft bore. Identifying numbers are used on cylinder and covers to prevent mismatching. Counterbores in the rocker box and rocker support covers accommodate the intercylinder rubber hoses and the steel flanges which enclose the camshaft between the cylinders.

c. The stem of the intake valve (50) and exhaust valve (49), for each cylinder, extends into the rocker box. Three nested springs, compressed between two retainers and secured to the valve stem by two cone-shaped locks, hold each valve to its seat. Each exhaust valve has a positive valve rotator which also serves as the lower spring retainer. Valve clearance adjusting screws with flat swivel pusher pads are mounted on one end of the valve rocker arms (1 and 2).

d. Forged steel valve rocker arms (1 and 2) with roller cam-followers are used. The rollers are hardened and honed to provide an extremely smooth and permanent contact surface. Hollow rocker arm shafts and drilled passages in the rocker arms convey oil to all moving parts.

1-14. Camshafts

NOTE

The key numbers shown below in parentheses refer to figure 1-8.

a. The left and right camshaft assemblies (3 and 10) are mounted, one on each bank, on the cylinders and operate the valve mechanism. The camshafts are hollow to provide oil passages for pressure lubrication to the valve parts and to permit deflection when the cylinders fire. Tubular molded rubber hoses enclose the camshafts between cylinders.

b. Each camshaft is driven by the accessory drive gear (12), accessory drive gearshaft assembly (8), camshaft drive bevel gearshaft (7), camshaft drive gearshaft (5), and camshaft driven gear (4) through an inclined quill type camshaft drive shaft (6). The drive shafts can be removed to permit separate rotation of the camshafts for engine timing. When camshafts are correctly positioned in relation to the crankshaft, the drive shafts have different number of splines on each end and this allows them to be inserted in the camshaft bevel gearshafts without disturbing relationship between camshafts and crankshaft.

1-15. Lubrication System

(figs. 1-9 and 1-10)

a. General. The main pressure oil pump draws oil from the pressure oil pump compartment in the oil pan. This compartment is fed by the scavenge oil pump which picks up oil from the front end of the oil pan and by oil which drains into the pressure compartment from the cover of the pressure pump compartment and the reserve compartment. The pressurized oil is forced through the engine oil coolers and oil filter to the engine oil galleries, bearings, turbosuperchargers, fuel injection pump and to the piston oil sprayer nozzles. These nozzles are located in the crankcase below each cylinder and provide a continuous oil spray to the pistons and cylinder walls. A pressure regulator valve, located on the right side of the crankshaft damper and oil filter housing is influenced by the pressure in the main bearing oil gallery and returns the incoming excess unfiltered oil to the oil pan.

b. Oil Pan. The oil pan (fig. 1-1) is a one-piece aluminum alloy casting divided into a pressure oil pump compartment, oil reserve compartment, and the sump compartment at the front of the pan. Cored passages from each of the compartments terminate at a central outlet and permits draining all of the compartments from a single drainage point. A cored passage also permits draining the oil coolers and oil filter compartment directly without permitting any sludge to enter the oil pan. The oil pan is designed to maintain a constant oil level above the main pressure oil pump pickup tube in the pressure oil pump compartment during vehicle operation regardless of the angle at which the engine may be inclined.

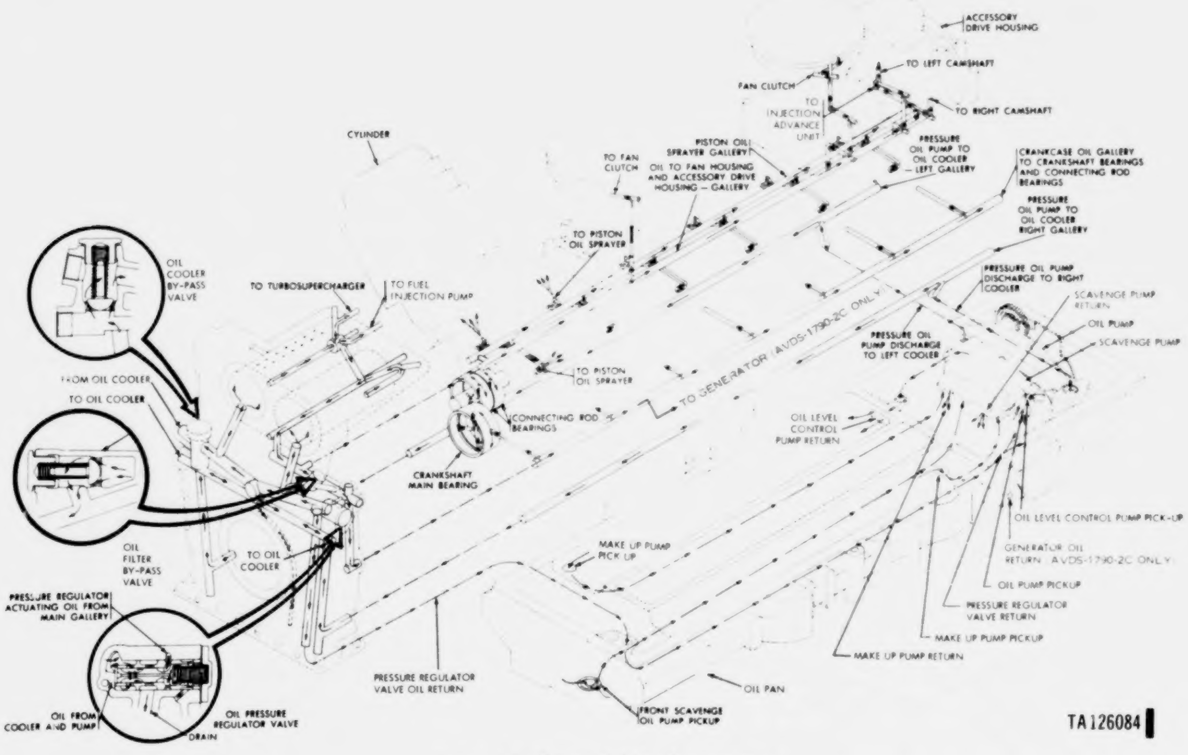

ACCESSORY DRIVE HOUSING
TO LEFT CAMSHAFT
FAN CLUTCH
TO INJECTION ADVANCE UNIT
TO RIGHT CAMSHAFT
CYLINDER
PISTON OIL SPRAYER GALLERY
PRESSURE OIL PUMP TO OIL COOLER – LEFT GALLERY
TO FAN CLUTCH
OIL TO FAN HOUSING AND ACCESSORY DRIVE HOUSING – GALLERY
CRANKCASE OIL GALLERY TO CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS
PRESSURE OIL PUMP TO OIL COOLER RIGHT GALLERY
TO PISTON OIL SPRAYER
OIL COOLER BY-PASS VALVE
TO TURBOSUPERCHARGER
TO FUEL INJECTION PUMP
PRESSURE OIL PUMP DISCHARGE TO RIGHT COOLER
SCAVENGE PUMP RETURN
OIL PUMP
SCAVENGE PUMP
TO GENERATOR (AVDS-1790-2C ONLY)
PRESSURE OIL PUMP DISCHARGE TO LEFT COOLER
FROM OIL COOLER
TO OIL COOLER
TO PISTON OIL SPRAYER
CONNECTING ROD BEARINGS
OIL LEVEL CONTROL PUMP RETURN
CRANKSHAFT MAIN BEARING
OIL LEVEL CONTROL PUMP PICK-UP
MAKE UP PUMP PICK UP
GENERATOR OIL RETURN (AVDS-1790-2C ONLY)
OIL FILTER BY-PASS VALVE
TO OIL COOLER
OIL PUMP PICKUP
PRESSURE REGULATOR ACTUATING OIL FROM MAIN GALLERY
PRESSURE REGULATOR VALVE RETURN
MAKE UP PUMP PICKUP
MAKE UP PUMP RETURN
PRESSURE REGULATOR VALVE OIL RETURN
OIL PAN
OIL FROM COOLER AND PUMP
OIL PRESSURE REGULATOR VALVE
DRAIN
FRONT SCAVENGE OIL PUMP PICKUP
TA126084

Figure 1-9. Engine lubrication system.

c. Oil Pump. The oil pump assembly consists of four sections combined as a single unit. The scavenge oil pump section of the unit picks up oil from the front end compartment of the oil pan and delivers it to the main pressure pump oil compartment. The main pressure oil pump section picks up oil from its respective compartment and supplies oil to the engine oil galleries, bearings, and to the piston oil sprayer nozzles. The level in the pressure pump compartment is maintained by a dual inlet leveling pump which returns any excess oil to the reserve compartment. Oil is pumped from the reserve compartment by two make up pumps in a single pump section. These pumps pick up oil from opposite corners of the reserve compartment and discharge it into the pressure pump compartment. The dual pump design insures return of oil from the reserve compartment under all operating conditions, cold oil, slope operation, etc.

d. Oil Filters and Control Valves. The engine oil filters (fig. 1-3) and the bypass valve are located in the crankshaft damper and oil filter housing at the front of the engine. All engine oil passes through the oil filters. The oil filter bypass valve opens at a differential pressure of 35.6 psi. The bypass valve permits oil to bypass the filters in the event that they become clogged.

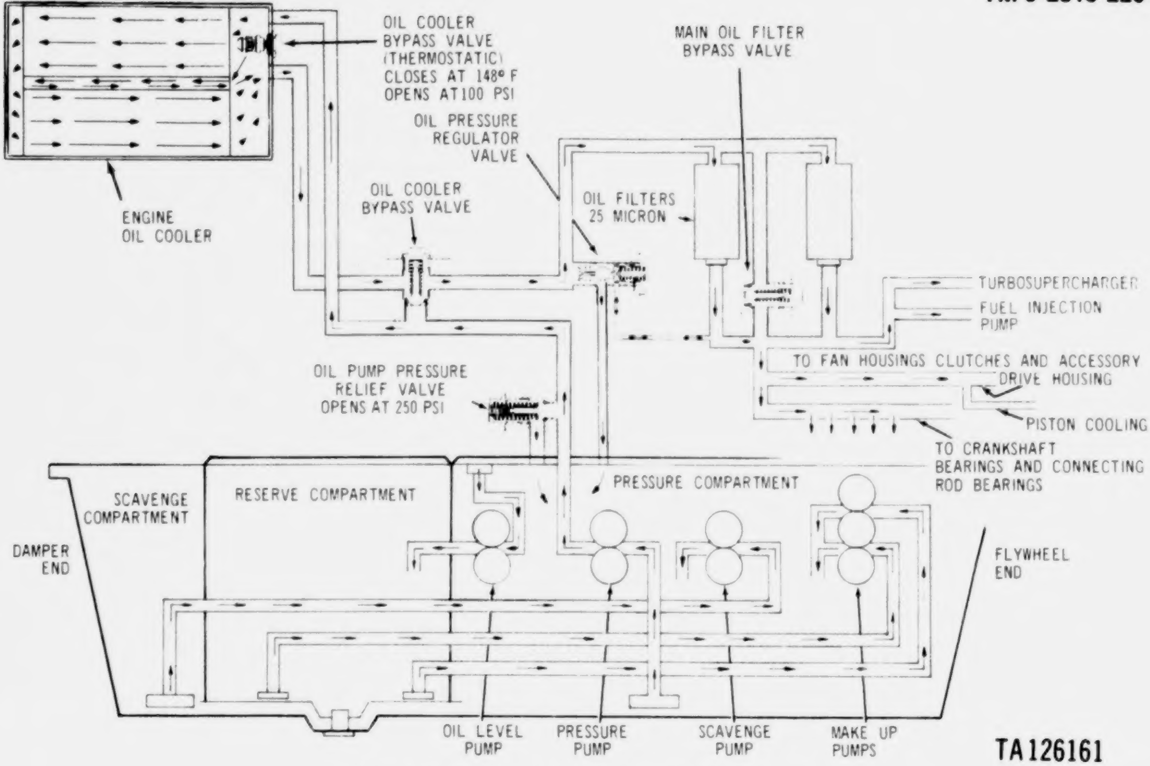

OIL COOLER BYPASS VALVE (THERMOSTATIC) CLOSES AT 148° F OPENS AT 100 PSI
MAIN OIL FILTER BYPASS VALVE
OIL PRESSURE REGULATOR VALVE
ENGINE OIL COOLER
OIL COOLER BYPASS VALVE
OIL FILTERS 25 MICRON
TURBOSUPERCHARGER
FUEL INJECTION PUMP
TO FAN HOUSINGS CLUTCHES AND ACCESSORY DRIVE HOUSING
OIL PUMP PRESSURE RELIEF VALVE OPENS AT 250 PSI
PISTON COOLING
TO CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS
SCAVENGE COMPARTMENT
RESERVE COMPARTMENT
PRESSURE COMPARTMENT
DAMPER END
FLYWHEEL END
OIL LEVEL PUMP
PRESSURE PUMP
SCAVENGE PUMP
MAKE UP PUMPS
TA126161

Figure 1-10. Engine oil flow control — flow diagram.

e. Oil Sampling System. The oil sampling system (fig. 1-1 and 1-6) on Models AVDS-1790-2C, AVDS-1790-2D, AVDS-1790-2CA, and AVDS-1790-2DA is located on top of the right bank transmission oil cooler. The system consists of two toggle valves, one each for engine oil and transmission oil, and the tubing necessary to draw oil samples from the respective oil coolers. The valves permit easy sampling of the engine and transmission oil to determine the necessity for an oil change. This feature eliminates unnecessary oil changes.

f. Oil Sampling Drain Cock. An oil sampling drain cock (fig. 1-7.3) is located on the oil filter cover of the Model AVDS-1790-2DR engine. The drain cock permits sampling of the engine oil to determine if its condition warrants an oil change.

1-16. Fuel System

a. Fuel Supply Pump Assembly (Models AVDS-1790-2C and AVDS-1790-2D). The engine driven vane type fuel supply pump assembly (fig. 1-3) is used to supply fuel under pressure to the fuel injection pump. The fuel pump is crankshaft driven by the fuel pump drive adapter (44, fig. 1-8) and the drive coupling (43) located at the front of the engine.

a.1. Fuel Supply Pump Assembly (Model AVDS-1790-2DR). A right angle drive is provided on the drive housing for the vane type fuel supply pump assembly. The pump is similar to the one used on Models AVDS-1790-2C and AVDS-1790-2D except that it rotates counterclockwise. The drive housing is lubricated with oil externally routed from the engine main oil gallery on the right side of the crankcase.

b. Fuel Injection Metering Pump. The fuel injection metering pump is located in the "V" of the engine between the fan drive housings, and supplies fuel under high pressure to each cylinder. The pump is driven at engine speed from the fan drive housing located at the rear of the engine. A fuel injection pump advance assembly (9, fig. 1-8) is incorporated in the accessory drive housing to automatically provide a gradual degree advance of injection timing during the engine speed range from idle to 1800 rpm.

c. Fuel Injector Nozzles and Tubes. Twelve fuel injector nozzles (fig. 1-11), one per cylinder, are used to inject fuel into the combustion chambers. Twelve fuel injector tubes of equal length carry the fuel from the fuel injection pump to the nozzles. The nozzles on each cylinder bank are interconnected by fuel return lines to provide a path for the return of excess fuel.

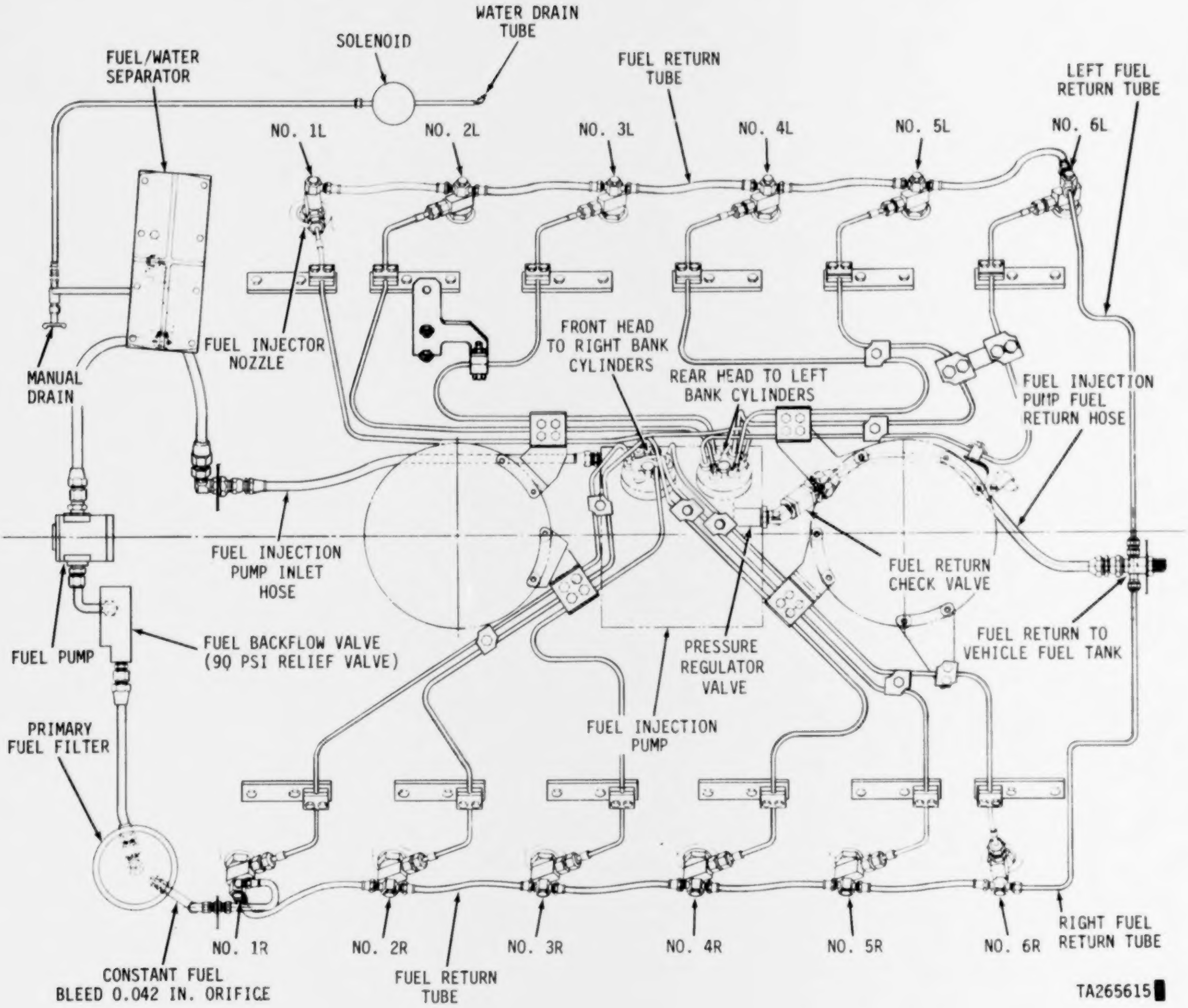

FUEL/WATER SEPARATOR
SOLENOID
WATER DRAIN TUBE
FUEL RETURN TUBE
LEFT FUEL RETURN TUBE
NO. 1L
NO. 2L
NO. 3L
NO. 4L
NO. 5L
NO. 6L
MANUAL DRAIN
FUEL INJECTOR NOZZLE
FRONT HEAD TO RIGHT BANK CYLINDERS
REAR HEAD TO LEFT BANK CYLINDERS
FUEL INJECTION PUMP FUEL RETURN HOSE
FUEL INJECTION PUMP INLET HOSE
FUEL RETURN CHECK VALVE
FUEL PUMP
FUEL BACKFLOW VALVE (90 PSI RELIEF VALVE)
PRESSURE REGULATOR VALVE
FUEL RETURN TO VEHICLE FUEL TANK
PRIMARY FUEL FILTER
FUEL INJECTION PUMP
NO. 1R
NO. 2R
NO. 3R
NO. 4R
NO. 5R
NO. 6R
RIGHT FUEL RETURN TUBE
CONSTANT FUEL BLEED 0.042 IN. ORIFICE
FUEL RETURN TUBE
TA265615

Figure 1-11. Main fuel system – schematic diagram, models AVDS-1790-2C and AVDS-1790-2D.

d. Fuel Purge System. A manually operated purge pump is provided in the vehicle operator's compartment and is used to clear the engine main fuel system and flame heater system of air, and fill them with fuel. Most of the purged air is removed through bleeder valves, located in the top of the primary fuel filter and the fuel/water separator filter. The rest of the air is forced through the main fuel tubes into the fuel return lines and on to the vehicle fuel tanks. Water is removed from the system by a constant bleed orifice in the primary fuel filter and an automatic water drain in the fuel/water separator filter.

e. Fuel Filters (figs. 1-2 and 1-3). The replaceable element type primary fuel filter is mounted on the right front of the engine and is equipped with a constant bleed orifice and drain line which constantly removes a metered amount of fuel and returns it to the main fuel tank through the fuel injector nozzle drain lines. This continuous drain, from the bottom of the filter, removes water in the free state that has been filtered from the fuel by the primary fuel filter element. The replaceable element fuel/water separator type filter is mounted on the left front of the engine. Fuel from the vehicle fuel tank passes through the primary filter before entering the engine fuel pump. The pump delivers fuel to the fuel/water separator filter and on to the fuel injection pump. Excess fuel provides pump cooling as it flows through the fuel injection pump hydraulic heads and is returned to the fuel tanks (figs. 1-11 and 1-11.1) The fuel/water separator filter unit has three replaceable elements and contains a chamber for collecting water. The two outer elements are coalescer elements and will remove emulsified water that has passed through the primary filter. The center element is a fuel filter element. The water removed from the fuel is automatically drained from the filter housing. Two water sensing probes are located in the filter housing. When the water level reaches the upper probe, an electrical circuit is completed, a solenoid valve opens and allows the water to drain. The valve closes when the water level reaches the lower probe. A drain cock is installed so the fuel/water separator may be drained manually. The unit provides moisture-free and uncontaminated fuel to the injection pump. Both the primary filter and the fuel/water separator filter incorporate top mounted bleeder valves to assist in the removal of air from the fuel system.

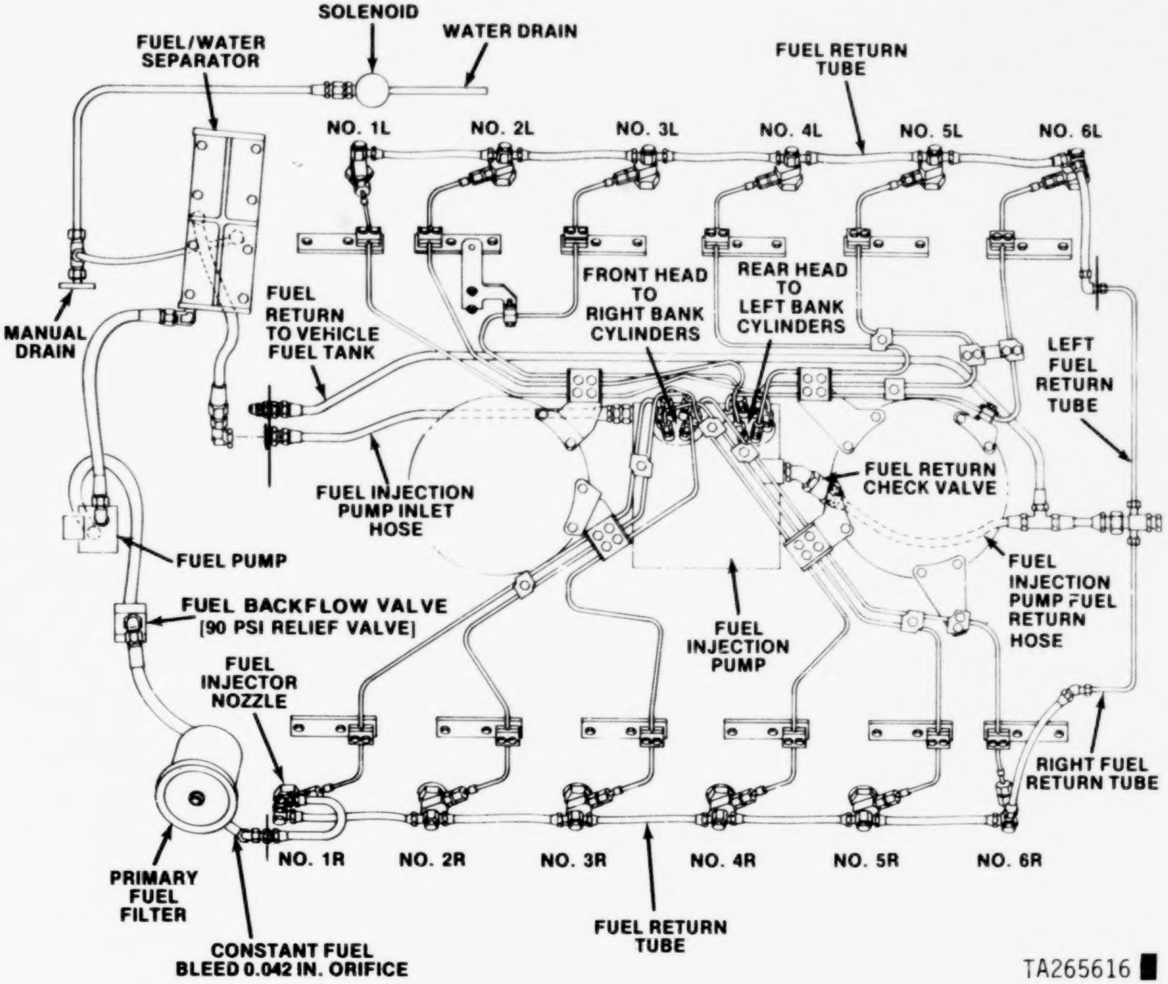

SOLENOID
WATER DRAIN
FUEL/WATER SEPARATOR
FUEL RETURN TUBE
NO. 1L
NO. 2L
NO. 3L
NO. 4L
NO. 5L
NO. 6L
FRONT HEAD TO RIGHT BANK CYLINDERS
REAR HEAD TO LEFT BANK CYLINDERS
FUEL RETURN TO VEHICLE FUEL TANK
MANUAL DRAIN
LEFT FUEL RETURN TUBE
FUEL RETURN CHECK VALVE
FUEL INJECTION PUMP INLET HOSE
FUEL PUMP
FUEL INJECTION PUMP FUEL RETURN HOSE
FUEL BACKFLOW VALVE [90 PSI RELIEF VALVE]
FUEL INJECTION PUMP
FUEL INJECTOR NOZZLE
RIGHT FUEL RETURN TUBE
NO. 1R
NO. 2R
NO. 3R
NO. 4R
NO. 5R
NO. 6R
PRIMARY FUEL FILTER
CONSTANT FUEL BLEED 0.042 IN. ORIFICE
FUEL RETURN TUBE
TA265616

Figure 1-11.1. Main fuel system – schematic diagram, Model AVDS-1790-2DR only.

f. Fuel Cutoff Solenoid. An electrically operated fuel cutoff solenoid is mounted in the fuel injection pump. The solenoid is normally open. A switch in the vehicle driver's compartment actuates the circuit to close the solenoid. Closing the solenoid cuts off fuel delivery from the fuel injection pump and stops the engine. A manually operated override shutoff is provided to permit stopping the engine in the event of an electrical failure.

g. Fuel Return Check Valve. A fuel return check valve (fig. 1-11 and fig. 1-11.1) is installed between the fuel injection pump fuel return outlet and the fuel return hose assembly. The valve prevents fuel flowing back to the injection pump when the fuel supply is closed.

1-17. Manifold Air Induction and Heater System

a. Turbosupercharger Assemblies. Exhaust gas driven turbosupercharger assemblies (figs. 1-1 and 1-2), one for each bank of cylinders, are mounted on each side of the engine, at the rear. The turbosuperchargers increase the pressure of the intake air thereby delivering a higher density air to the cylinders as compared with a nonsupercharged engine. This higher density air, with a proper fuel flow, increases engine power.

b. Intake Manifold Heater (fig. 1-12).

(1) The intake manifold (figs. 1-1 and 1-2), which distributes induction air to each bank of cylinders, is equipped with an electrically operated flame type intake manifold heater. The heater is provided as an aid for cold weather starting and cold weather operations. Operation of the heater switch (in the vehicle operator's compartment) energizes the manifold heater fuel solenoid valve, the heater ignition unit, and spark plug for each heater simultaneously. Fuel is hand pumped through the manifold heater fuel filter and fuel solenoid valve and sprayed into the intake manifold. The fuel is ignited by the spark plug and burns in the intake manifold as the engine is cranking, and the flame heats the incoming air. This flame-heated air and the products of combustion are fed directly into the cylinders with little heat loss. This results in an immediate engine response, and assures complete combustion at low engine rpm and at no-load operating conditions with low ambient temperature.

(2) The manifold heater fuel inlet solenoid valve prevents fuel pumped by the fuel pump assembly from entering the air intake manifold heater unless the heater system is energized. A manifold heater fuel return check valve and solenoid valve are located at the rear of the engine. The solenoid valve is also energized (opened) when the ignition unit and heater spark plugs are energized to permit excess fuel to be returned to the fuel tanks. The main fuel backflow valve prevents back flow of the fuel when the purge pump in the driver's compartment is actuated.

1-18. Exhaust System and Turbosupercharger

a. The exhaust system consists of four manifolds, one for each group of three adjacent cylinders. The two exhaust manifolds on each cylinder bank are connected to the turbosupercharger on their respective side of the engine.

b. Exhaust gases from each side of the engine enter a turbosupercharger and are forced around a turbine housing, radially inward, and through a nozzle ring toward the turbine wheel. The exhaust gases drive the turbine wheel, which in turn drives the compressor wheel since both wheels are on a common shaft. Intake manifold air enters at the center of the compressor wheel and flows radially outward through a diffuser section into the compressor housing. The air at increased velocity then leaves through a tangential outlet on the outside of the compressor housing and enters the intake manifold.

c. The exhaust gases are expelled from the turbosuperchargers into the vehicle exhaust system.

1-19. Cooling System

NOTE

The key numbers shown below in parentheses refer to fig. 1-8.

a. Fans. The top of the engine is shrouded to house two cooling fans (48 and 40) which draw cool air from the underside of the engine, through the cylinder fins, and discharge the hot air vertically from the top shroud. The fans are attached to adapters (39) and are mounted on shafts which are driven through a fan drive clutch assembly (38). The rear fan clutch is driven by the rear fan drive shaft (34), fan drive bevel gearshaft (33), and fan driven gearshaft (35). The front fan clutch is driven by the front fan drive shaft (32) and another fan driven gearshaft (35).

b. Fan Drive and Clutch (fig. 1-13). The fan clutch is oil cooled. The fan clutch drive and driven disks are loaded by the centrifugal action of clutch balls and springs housed in the clutch assembly. The balls and springs are in the driven member and apply upward force to the clutch disks. The clutch oil enters the fan drive vertical shaft from the fan drive housing through an annular groove in the shaft. The oil flows through a central hole in the shaft to a distributor where it is dispersed to the ball bearings and to the clutch disks. The oil moves between the clutch disks by centrifugal action and drains back through the fan drive housing into the engine oil pan.

c. Engine and Transmission Oil Coolers (fig. 1-1). All transmission and engine oil cooling is accomplished by external oil coolers. The oil coolers are located on the sides of the engine above the cylinders. Air is drawn through the oil coolers by the cooling fans. A thermostatic control valve in each oil cooler controls the temperature of the oil from the cooler by permitting cold oil to bypass the coolers. This valve also permits oil to bypass the cooler in the event that the cooler becomes clogged.

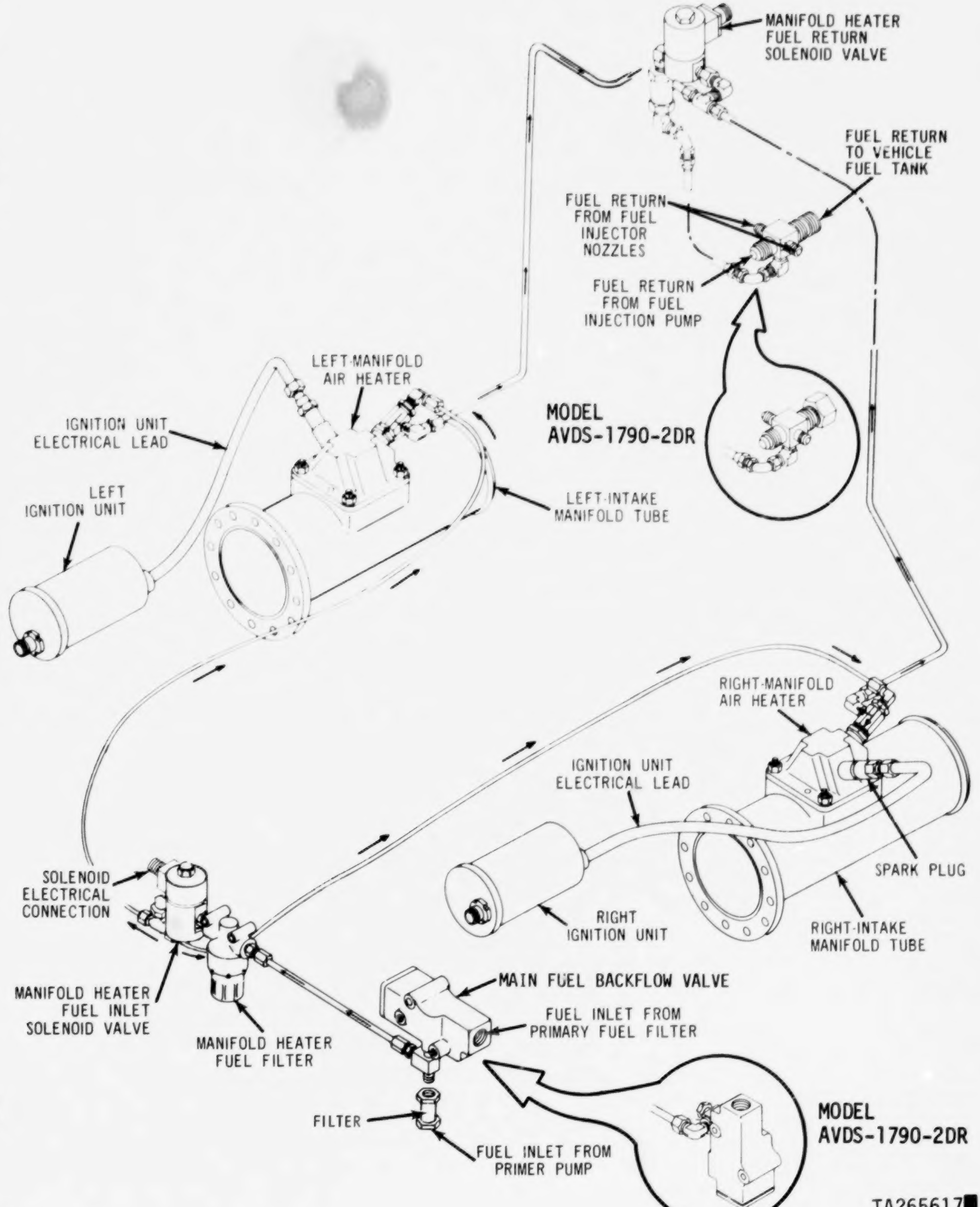

MANIFOLD HEATER FUEL RETURN SOLENOID VALVE
FUEL RETURN TO VEHICLE FUEL TANK
FUEL RETURN FROM FUEL INJECTOR NOZZLES
FUEL RETURN FROM FUEL INJECTION PUMP
LEFT-MANIFOLD AIR HEATER
IGNITION UNIT ELECTRICAL LEAD
MODEL AVDS-1790-2DR
LEFT IGNITION UNIT
LEFT-INTAKE MANIFOLD TUBE
RIGHT-MANIFOLD AIR HEATER
IGNITION UNIT ELECTRICAL LEAD
SOLENOID ELECTRICAL CONNECTION
SPARK PLUG
RIGHT IGNITION UNIT
RIGHT-INTAKE MANIFOLD TUBE
MAIN FUEL BACKFLOW VALVE
FUEL INLET FROM PRIMARY FUEL FILTER
MANIFOLD HEATER FUEL INLET SOLENOID VALVE
MANIFOLD HEATER FUEL FILTER
FILTER
FUEL INLET FROM PRIMER PUMP
MODEL AVDS-1790-2DR
TA265617

Figure 1-12. Manifold air induction heater system — flow diagram.

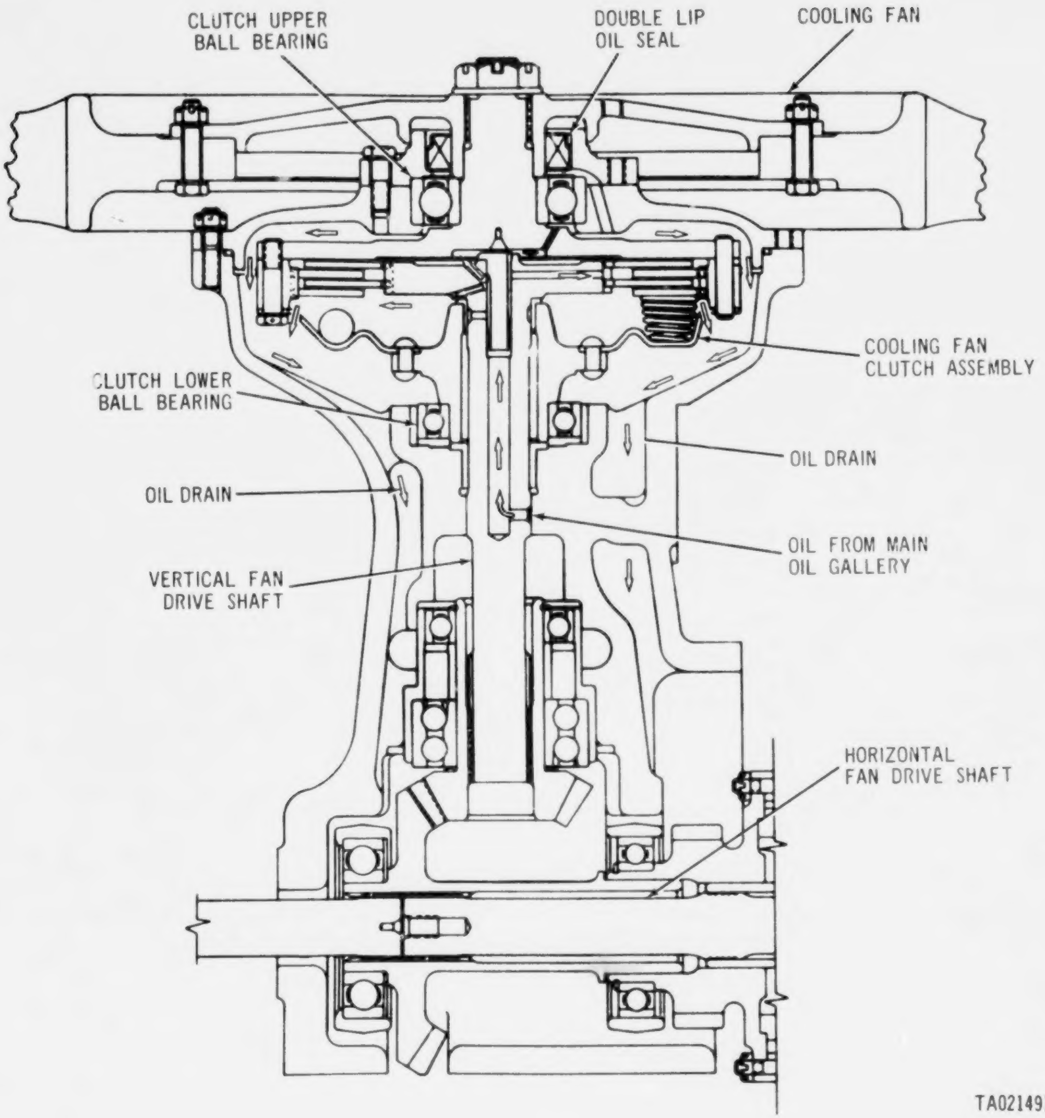

CLUTCH UPPER BALL BEARING
DOUBLE LIP OIL SEAL
COOLING FAN
COOLING FAN CLUTCH ASSEMBLY
CLUTCH LOWER BALL BEARING
OIL DRAIN
OIL DRAIN
OIL FROM MAIN OIL GALLERY
VERTICAL FAN DRIVE SHAFT
HORIZONTAL FAN DRIVE SHAFT
TA021491

Figure 1-13. Mechanical cooling fan clutch – sectional view.

1-20. Crankcase Breather and Fire Extinguisher Systems

(Fig. 1-14).

a. Crankcase Breather System. The engine crankcase breather system is completely enclosed which allows the engine to be submerged without entrance of water and permits the crankcase to be vented. The breather system is vented through the left turbosupercharger exhaust outlet into the vehicle exhaust system.

b. Fire Extinguisher System. The engine is equipped with a fire extinguisher tube located in the "V". This tube is connected to the engine compartment fire extinguisher system. The tube has small holes drilled along the entire length to direct the carbon dioxide (CO_2) fire extinguisher fluid in predetermined directions around cylinders, fuel injection pump, and intercylinder components in case of fire.

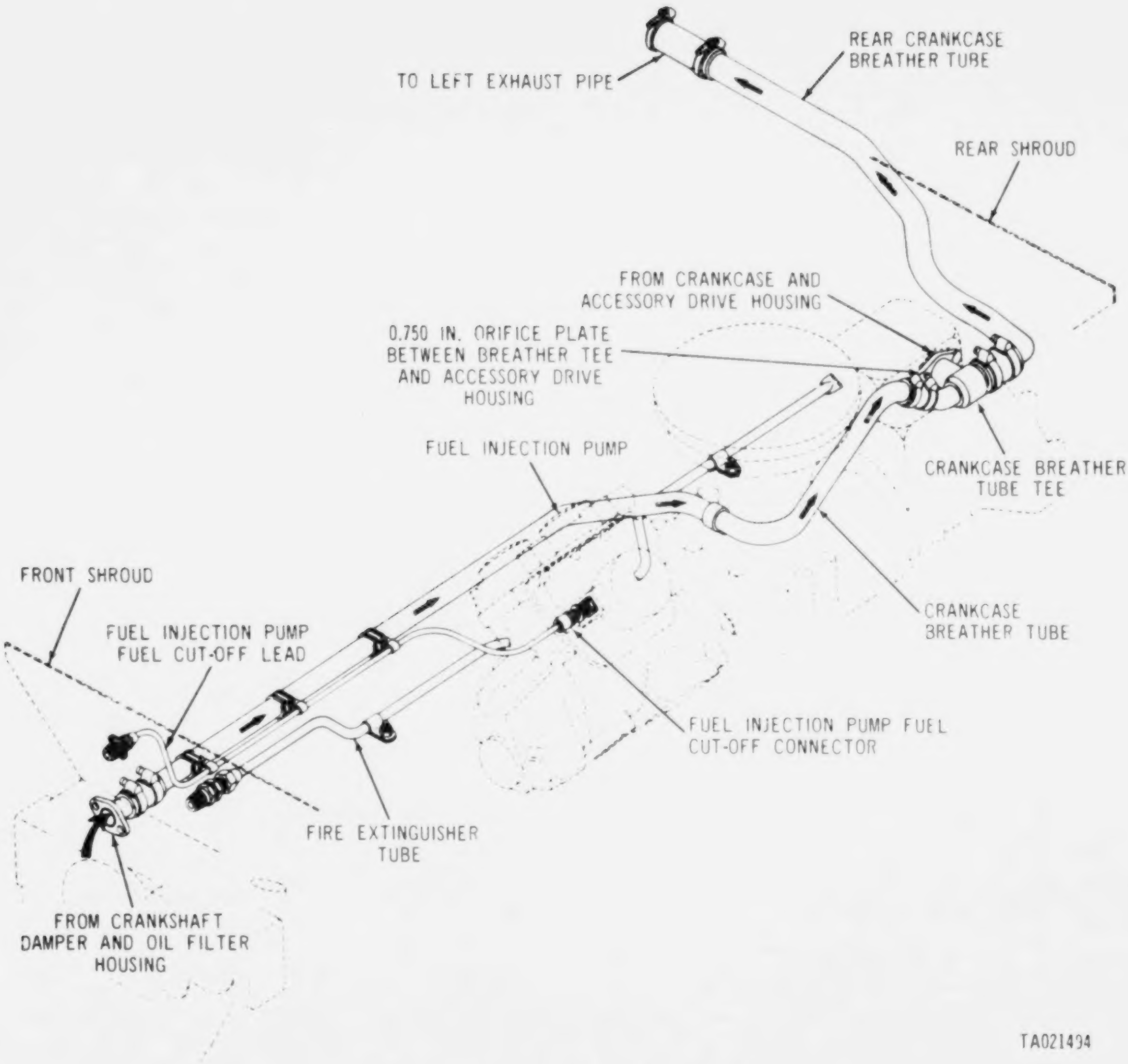

REAR CRANKCASE
BREATHER TUBE
TO LEFT EXHAUST PIPE
REAR SHROUD
FROM CRANKCASE AND
ACCESSORY DRIVE HOUSING
0.750 IN. ORIFICE PLATE
BETWEEN BREATHER TEE
AND ACCESSORY DRIVE
HOUSING
FUEL INJECTION PUMP
CRANKCASE BREATHER
TUBE TEE
FRONT SHROUD
CRANKCASE
BREATHER TUBE
FUEL INJECTION PUMP
FUEL CUT-OFF LEAD
FUEL INJECTION PUMP FUEL
CUT-OFF CONNECTOR
FIRE EXTINGUISHER
TUBE
FROM CRANKSHAFT
DAMPER AND OIL FILTER
HOUSING
TA021494

Figure 1-14. Engine crankcase breather and fire extinguisher systems – flow diagram.

1-21. Transmitters and Switches

a. Oil Pressure Gage Transmitter (figs. 1-1 and 1-7.1). The electrical oil pressure gage transmitter is located to the front of the crankcase at the opening in the gallery line below the No. 1 right cylinder. This sealed transmitter consists of a threaded plate to which a diaphragm, a radially notched spring, and an overload guard plate are crimped. Electrical resistance in the transmitter varies directly as the oil pressure varies. The resulting variation in the current is transmitted to the electrical oil gage on the vehicle instrument panel.

b. Low Oil Pressure Warning Light Switch (figs. 1-1 and 1-7.1). The low oil pressure warning light switch is furnished with the engine and is located at the lower right side of the crankshaft damper and oil filter housing. The electrical contact points in this switch close when the oil pressure in the main oil gallery is below 11 ± 2 psi. Completion of the electrical circuit will light the low pressure warning lamp on the vehicle instrument panel.

c. Oil Temperature Transmitter. The oil temperature gage transmitter is located at the upper right side of the crankshaft damper and oil filter housing above the oil pressure regulator valve.

d. High Engine Oil Temperature Warning Light Switch. The oil temperature warning light switch is located in the oil passage above the oil pressure warning light switch in the right side of the crankshaft damper and oil filter housing. The warning light sending switch thermostatically controlled electrical contact points close when oil temperature in the engine main oil passage reaches 245 ± 5°. Completion of the electrical circuit will light the oil high temperature warning lamp on the vehicle instrument panel.

e. Auxiliary Generator High Oil Pressure Sending Switch (Model AVDS-1790-2DR only, fig. 1-7.1). The auxiliary generator high oil pressure sending switch is located at the right front of the crankcase in the tee that mounts the oil pressure gage transmitter. This switch prevents simultaneous operation of the main engine and auxiliary generating systems.

1-21.1 Smoke Generating System

The smoke generating system uses the engine fuel pump to supply diesel fuel, from the vehicle fuel tanks, to two solenoid valves mounted at the rear of the engine (fig. 1-14.1). When the solenoid valves are energized (opened) they allow diesel fuel to be sprayed into the engine exhaust system. The fuel vaporizes and exits together with the engine exhaust gases. The fuel vapor cools on contact with the ambient air and condenses to form a dense homogeneous smoke screen. The electrical power to energize the solenoid valves is supplied by the vehicle air cleaner blower motor circuit on Model AVDS-1790-2C, AVDS-1790-2CA, AVDS-1790-2D, and AVDS-1790-2DA engines, and the warning indicator and warning horn circuit on Model AVDS-1790-2DR engines. This prevents accidental activation of the smoke generating system when the engine is not running.

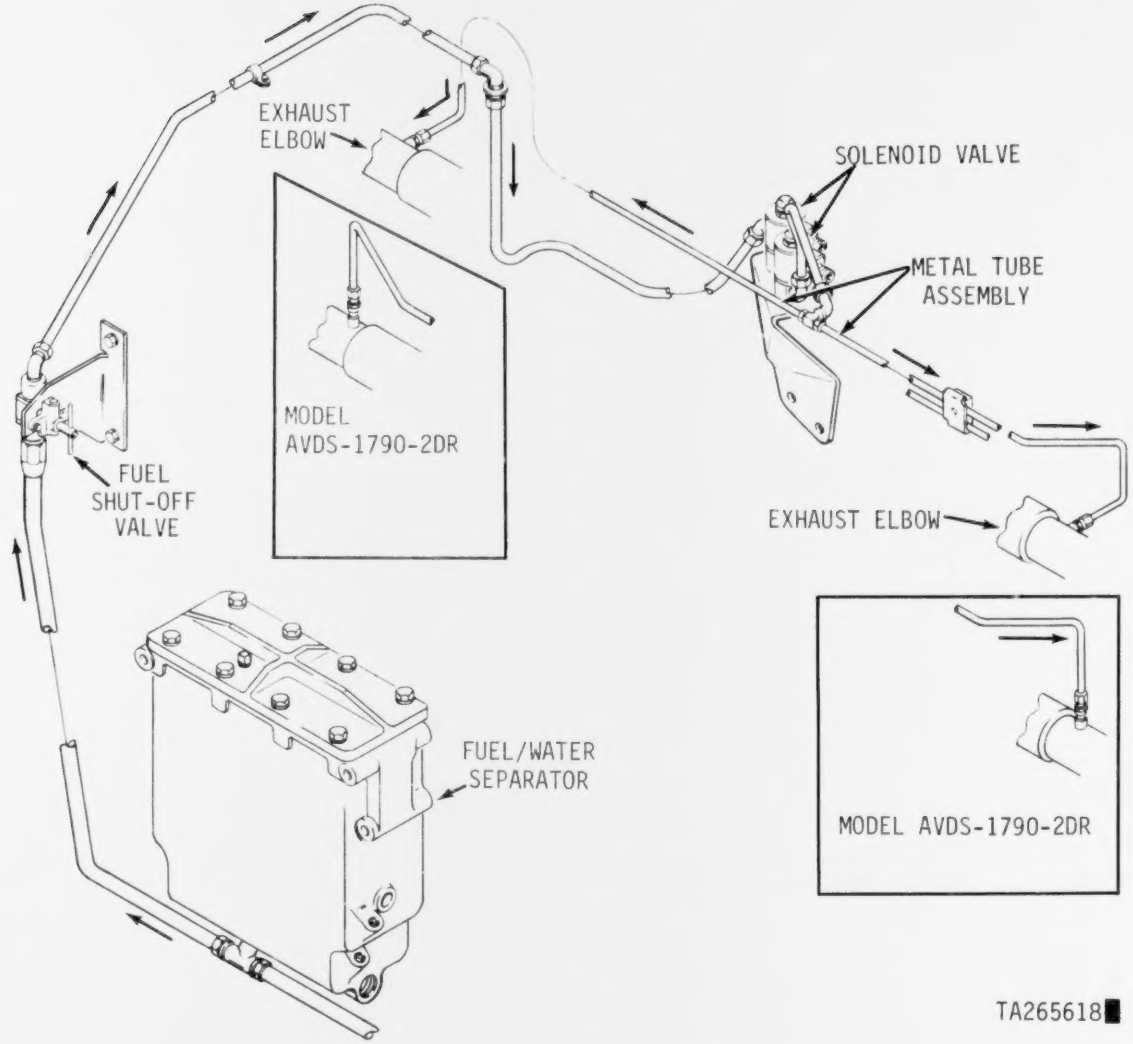

EXHAUST
ELBOW
SOLENOID VALVE
METAL TUBE
ASSEMBLY
MODEL
AVDS-1790-2DR
FUEL
SHUT-OFF
VALVE
EXHAUST ELBOW
FUEL/WATER
SEPARATOR
MODEL AVDS-1790-2DR
TA265618

Figure 1-14.1. Smoke generating system - flow diagram.

Section III. TABULATED DATA

1-22. General

Refer to pertinent organizational maintenance manual for the tabulated data pertaining to the general characteristics and performance of the engine.

1-23. Accessories

Accessory	*Manufacturer*	*Model*	*Part No.*
Generator (Models AVDS-1790-2C and AVDS-1790-2CA)	Bendix	30B95-3	11655469
Generator (Models AVDS-1790-2D, AVDS-1790-2DR and AVDS-1790-2DA)	Teledyne Walterboro	G22	10889713
Starter	Delco-Remy	1990272	11669795
	Delco-Remy	1109843	11669738
Starter Low Voltage Module	Cutler-Hammer	CH-SX-7EG1	11668620
Fuel Injection Metering Pump	American Bosch	PSB-12BT	11684129-1
Nozzle and Holder Assembly	American Bosch	AKN-212S-4862C	10912452-1
Fuel Supply Pump (Models AVDS-1790-2C, AVDS-1790-2CA, AVDS-1790-2D and AVDS-1790-2DA	Viking	FV492-4C	10882763-1
Fuel Supply Pump (Model AVDS-1790-2DR)	Viking	FV492-4D	8761431-1
Turbosupercharger	Schwitzer	5HDR	12275818
	Schwitzer (with dust detector)	5HDR	12314618
	AiResearch	T18	12275818
	AiResearch (with dust detector)	T18	12314618
Fuel Filter (primary)	Bendix Filter Div.	054615-02	11668617
Primary Fuel Filter Parts Kit			5704487
Fuel/Water Separator Filter	Facet Filter Products		11602063
Fuel/Water Separator Filter Parts Kit			5702738
Control Assembly, Fuel/Water Separator Automatic Drain	Classic Chemical	F-0301	11668625
Manifold Heater Fuel Filter	Bendix Filter Div.		7416350
Oil Filter Element	Commercial Filters Div.	9053-5040	11668619
Oil Filter Replacement Kit			5704486
Oil Pressure Gage Transmitter	Military Design		7416363
Oil Temperature Gage Transmitter	Military Design		7389566
High Oil Temperature Warning Light Switch	Military Design		7771274-1
Low Oil Pressure Warning Light Switch	Precision Sensors, Inc.	P27M-20	11668621
Ignition Unit, Manifold Heater	Bendix Corp.	10-516775-1	7062198
	Livingston Industries Inc.	305001	7062198
Auxiliary Generator Oil Pressure Switch (Model AVDS-1790-2DR)	Carter Carburetor	A3051S	10874979
Electrical Time Totalizing Meter	Benton Div.	28500	11640392
Manifold Air Heater Solenoid Valve	Skinner Electric Valve Div.		7062194
Water Separator Drain and Smoke Generating System Solenoid Valves	Skinner Electric Valve Div.	------	11668627

1-24. Engine

Make .... Teledyne Continental Motors, General Products Division
Type .... Diesel, air-cooled, V-12
Models .... AVDS-1790-2C, AVDS-1790-2D, and AVDS-1790-2DR

Dimensions, including shroud:	
Length (to transmission adapter):	
Models AVDS-1790-2C, AVDS-1790-2D, AVDS-1790-2CA and AVDS-1790-2DA	68.59 in.
Model AVDS-1790-2DR	72.50 in.
Width (overall, shrouds installed):	
Models AVDS-1790-2C, AVDS-1790-2D, AVDS-1790-2CA, and AVDS-1790-2DA	88.74 in.
Model AVDS-1790-2DR	70.25 in.
Height:	
Models AVDS-1790-2C and AVDS-1790-2D	45.50 in.
Model AVDS-1790-2DR	45.30 in.
Models AVDS-1790-2CA and AVDS-1790-2DA	47.19 in.
Displacement	1790 cu in.
Weight, dry (with accessories)	
Models AVDS-1790-2C and AVDS-1790-2D	4876 lbs.
Model AVDS-1790-2DR	4925 lbs.
Models AVDS-1790-2CA and AVDS-1790-2DA	4998 lbs.
Speed:	
Governed, full load	**2400 rpm**
Governed, no load	2260 rpm (max)
Idle	**700 rpm**
Winching speed:	
Model AVDS-1790-2DR	**1800 ± 25 prm, no load**
Horsepower, gross	**735 to 780 bhp at 2400 rpm**
Horsepower, net	**642 bhp at 2400 rpm**
Torque, gross	**1770 to 1842 lb-ft at 1800 rpm**
Torque, net	1585 lb-ft at 1800 rpm
Cylinders:	
Number	12
Arrangement	90° **upright "V"**
Numbering (from front):	
Left side	1L, 2L, 3L, 4L, 5L, 6L
Right side	1R, 2R, 3R, 4R, 5R, 6R
Firing Order	1R, 2L, 5R, 4L, 3R, 1L, 6R, 5L, 2R, 3L, 4R, 6L
Bore	5.750 in.
Pistons:	
Stroke	5.750 in.
Compression ratio	16:1
Displacement	149:1 cu in. per cylinder
Cooling:	
Type	Air cooled by two engine driven fans
Air Flow	20,000 cfm at 2400 rpm
Drive (from crankshaft)	Direct
Crankshaft rotation (viewed from front)	Clockwise
Camshafts:	
Number	2
Rotation (viewed from front)	Counterclockwise
Ignition	Compression
Fuel System:	
Induction	Supercharged
Air flow (at rated power and speed	2000 cfm
Fuel:	
Type	Diesel
Grade	40 cetane min
Specification	VV-F-800, Grade DF-2
Supply pressure (at injection pump inlet)	55-60 psi
Consumption at 750 hp and 2400 rpm	305 lbs per hr
Valve timing:	
Intake opens	**25° before top center (BTC)**
Intake closes	**55° after bottom center (ABC)**
Intake remains open	**260°**
Exhaust opens	**45° before bottom center (BBC)**

Exhaust closes	20 ° after top center (ATC)
Exhaust remains open	245°
Setting (0.100 in. clearance)	Intakes closes 32° after bottom center (ABC)
Valves:	
Lift	0.460 in.
Clearance (cold engine):	
Exhaust	0.025 in.
Intake	0.010 in.
Fuel injection metering pump timing:	
Static setting with injection advance in fuel retarded position	26° BTC
Lubrication:	
Normal oil temperature	180°F. at 60°F. ambient
Maximum oil temperature (out of cooler)	250°F.
Oil pressure (crankcase main oil gallery):	
700 rpm	15 psi (SAE 30 oil at 140° to 250°F)
2400 rpm	40 to 70 psi (SAE 30 oil at 180°F)
Oil pump output (SAE 30 oil at 180°F. at 2800 rpm of pump):	
Pressure pump	70 gpm
Scavenge pump	77 gpm
Oil Capacity (approximate):	
Dry engine	20.0 gallons
Oil and filter change	17.0 gallons
Manifold heater (cold weather starting and idle operation in cold weather)	
Type	Flame type, spark ignition
Spark plug (ignition) gap	0.094 in. to 0.114 in.
Pump (hand operated from driver's compartment)	90 psi
Spray nozzle flow	1.5 to 2.2 lbs/hr
Fuel (type)	same as engine fuel

1-25. Drive Ratios and Rotation (From Front)

Camshafts	0.500:1 counterclockwise
Cooling fans	2.000:1 clockwise
Generator	3.200:1 clockwise
Starter	11.846:1 clockwise
Fuel injection metering pump	1.000:1 clockwise
Fuel supply pump Models AVDS-1790-2C, AVDS-1790-2D, AVDS-1790-2CA and AVDS-1790-2DA	1.000:1 clockwise
Fuel supply pump Model AVDS-1790-2DR	1.000:1 counterclockwise
Power take-off Model AVDS-1790-2DR	1.000:1 clockwise
Oil pump	1.327:1 clockwise
Tachometer drive	0.500:1 counterclockwise

CHAPTER 2
DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-1. General

Authorized repair parts for the engine are listed in TM 9-2815-220-34P, which is the authority for requisitioning replacement parts.

2-2. Repair Parts

a. Repair parts required for the maintenance of the engines are issued to supporting maintenance personnel for the replacement of parts which have been worn, broken or are otherwise unserviceable, and for parts which have been salvaged and stocked for future use on repairable engines.

b. Repair parts for engine installation or replacement (attaching or associated external parts) are listed in organizational repair parts manuals.

c. Repair parts for engine accessories are listed in the following technical manuals:

(1) TM 9-2910-212-34&P–Pump, Fuel Metering and Distributing.

(2) TM 9-2910-213-34–Pump, Fuel, Engine, Assembly (Models AVDS-1790-2C and AVDS-1790-2D only).

(3) TM 9-2920-252-34&P–Generator, Engine, Assembly (Model AVDS-1790-2C).

(4) TM 9-2920-224-35–Generator, Engine, Assembly (Model AVDS-1790-2D and AVDS-1790-2DR).

(5) TM 9-2920-232-34–Starter, Engine, Electrical, Assembly.

(6) TM 9-2990-205-34&P–Turbosupercharger, Engine, Assembly.

(7) TM 9-2990-206-34&P–Turbosupercharger, Engine, Assembly.

2-3. Mandatory Replacement Parts

To expedite repair and rebuild of the engines, it is economically advantageous to replace certain parts rather than perform the required cleaning and inspection necessary to assure that the parts are suitable for continued use. Gaskets, packings, oil seals and other similar parts are always replaced at engine rebuild. Refer to TM 9-2815-220-34P for 100 percent replacement items.

2-4. Common Tools and Equipment

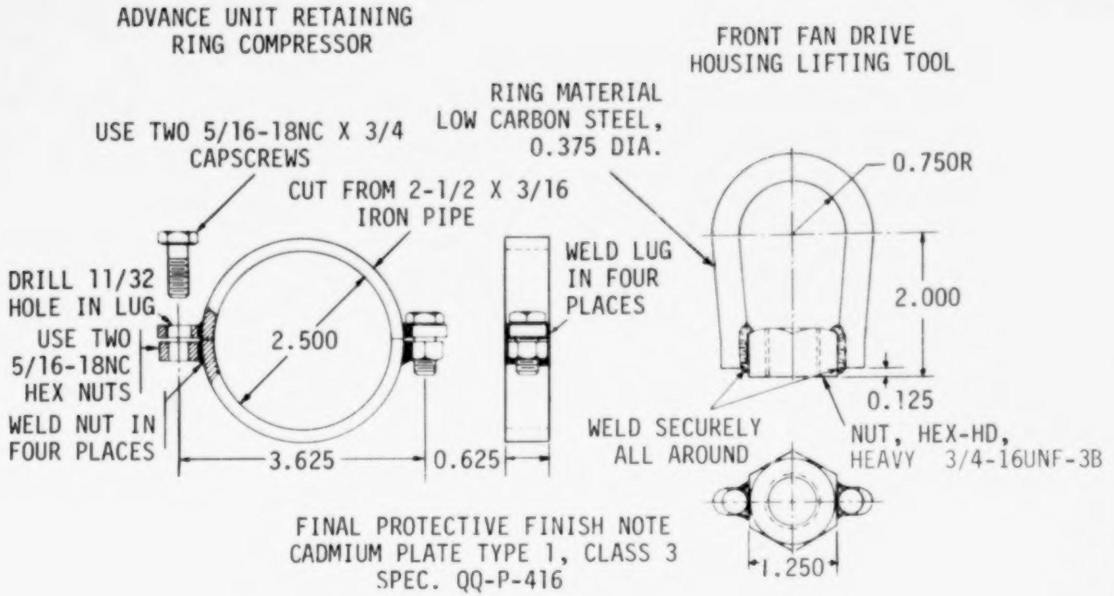
Standard and commonly used tools and equipment having general application to the engines are authorized by tables of allowance (TA) and tables of organization and equipment (TOE).

2-5. Special Tools and Equipment

The special tools and equipment listed in table 2-1 are necessary to perform the field maintenance and repair operations described in this manual. Refer to TM 9-2815-220-34P which is the authority for requisitioning special tools, kits, and equipment.

2-6. Improvised Tools and Equipment

The improvised tools illustrated in figures 2-1 through 2-3 apply only to Direct Support and General Support. Principal dimensions are shown to enable maintenance personnel to fabricate tools locally if desired. These tools are of chief value to maintenance organizations engaged in repairing a large number of identical components; however, these improvised tools are not available for issue. The improvised tools illustrated in figure 2-1 are used for compressing the advance unit cover internal retaining ring, lifting the front fan drive housing and clutch assembly, and turning the engine (on Model AVDS-1790-2DR only). The improvised tool illustrated in figures 2-1.2 through 2-1.5 is used to replace connecting rod bushing-type bearings. The puller for removing the drive shaft half and/or the injection pump half of the fuel injection pump coupling is illustrated in figure 2-2. The improvised tool illustrated in figure 2-3 is used to remove the oil pressure regulating valve sleeve.



ADVANCE UNIT RETAINING RING COMPRESSOR

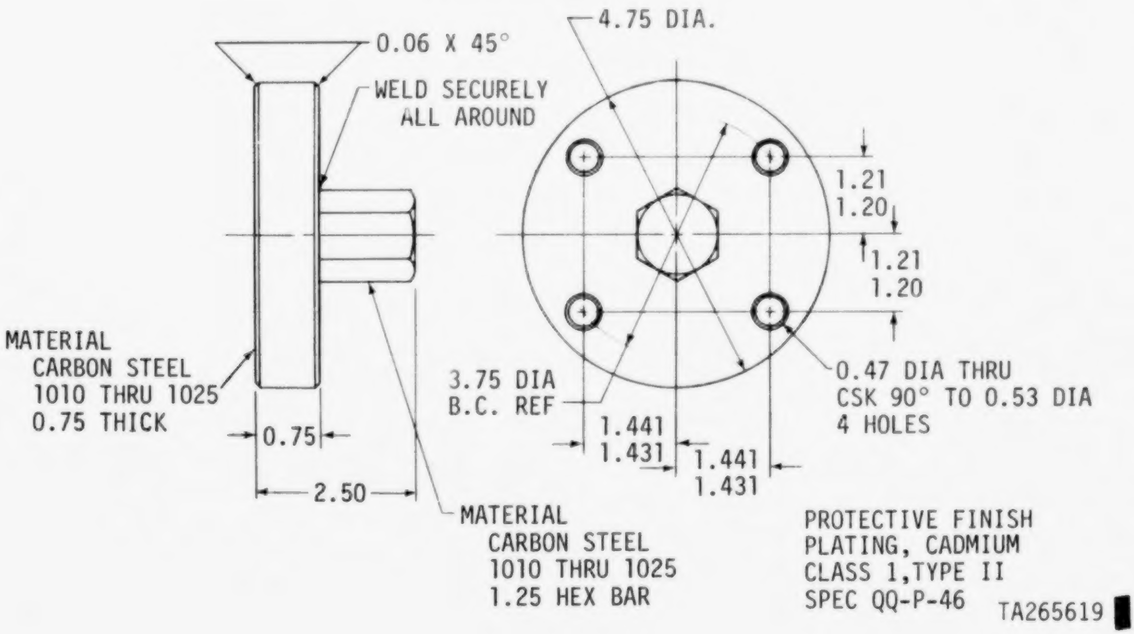
FRONT FAN DRIVE HOUSING LIFTING TOOL

USE TWO 5/16-18NC X 3/4 CAPSCREWS
CUT FROM 2-1/2 X 3/16 IRON PIPE
DRILL 11/32 HOLE IN LUG
USE TWO 5/16-18NC HEX NUTS
2.500
WELD NUT IN FOUR PLACES
WELD LUG IN FOUR PLACES
3.625
0.625
RING MATERIAL LOW CARBON STEEL, 0.375 DIA.
0.750R
2.000
0.125
WELD SECURELY ALL AROUND
NUT, HEX-HD, HEAVY 3/4-16UNF-3B
1.250

FINAL PROTECTIVE FINISH NOTE
CADMIUM PLATE TYPE 1, CLASS 3
SPEC. QQ-P-416

NOTE: ALL DIMENSIONS ARE IN INCHES

TOOL, ENGINE TURNING



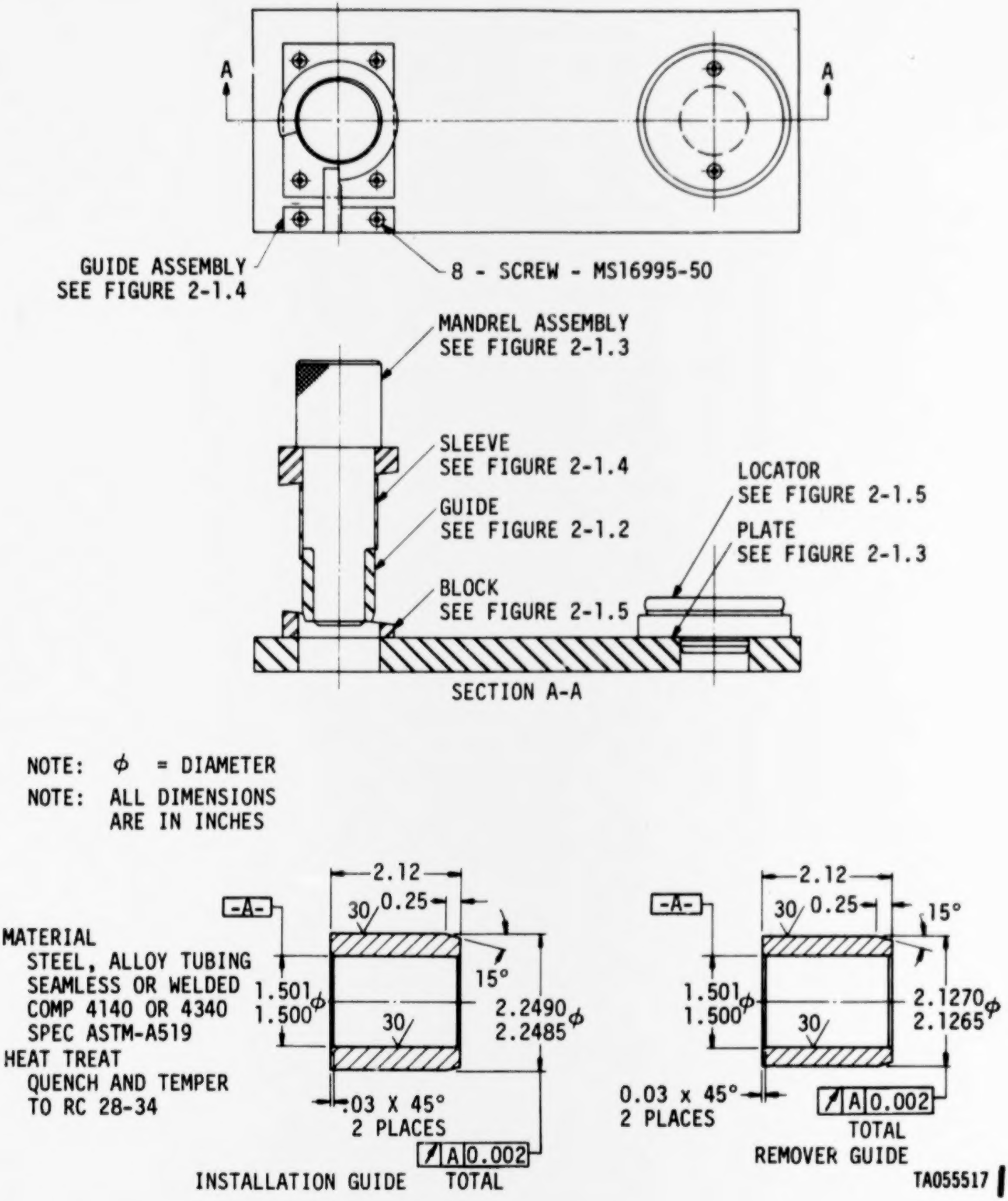
0.06 X 45°
WELD SECURELY ALL AROUND
4.75 DIA.
1.21
1.20
1.21
1.20
MATERIAL CARBON STEEL 1010 THRU 1025 0.75 THICK
0.75
2.50
MATERIAL CARBON STEEL 1010 THRU 1025 1.25 HEX BAR
3.75 DIA B.C. REF
1.441
1.431
1.441
1.431
0.47 DIA THRU CSK 90° TO 0.53 DIA 4 HOLES

PROTECTIVE FINISH
PLATING, CADMIUM
CLASS 1,TYPE II
SPEC QQ-P-46

TA265619

Figure 2-1. Improvised tools, ring compressor, lifting tool, and engine turning tool.

Figure 2-1. 1 deleted.

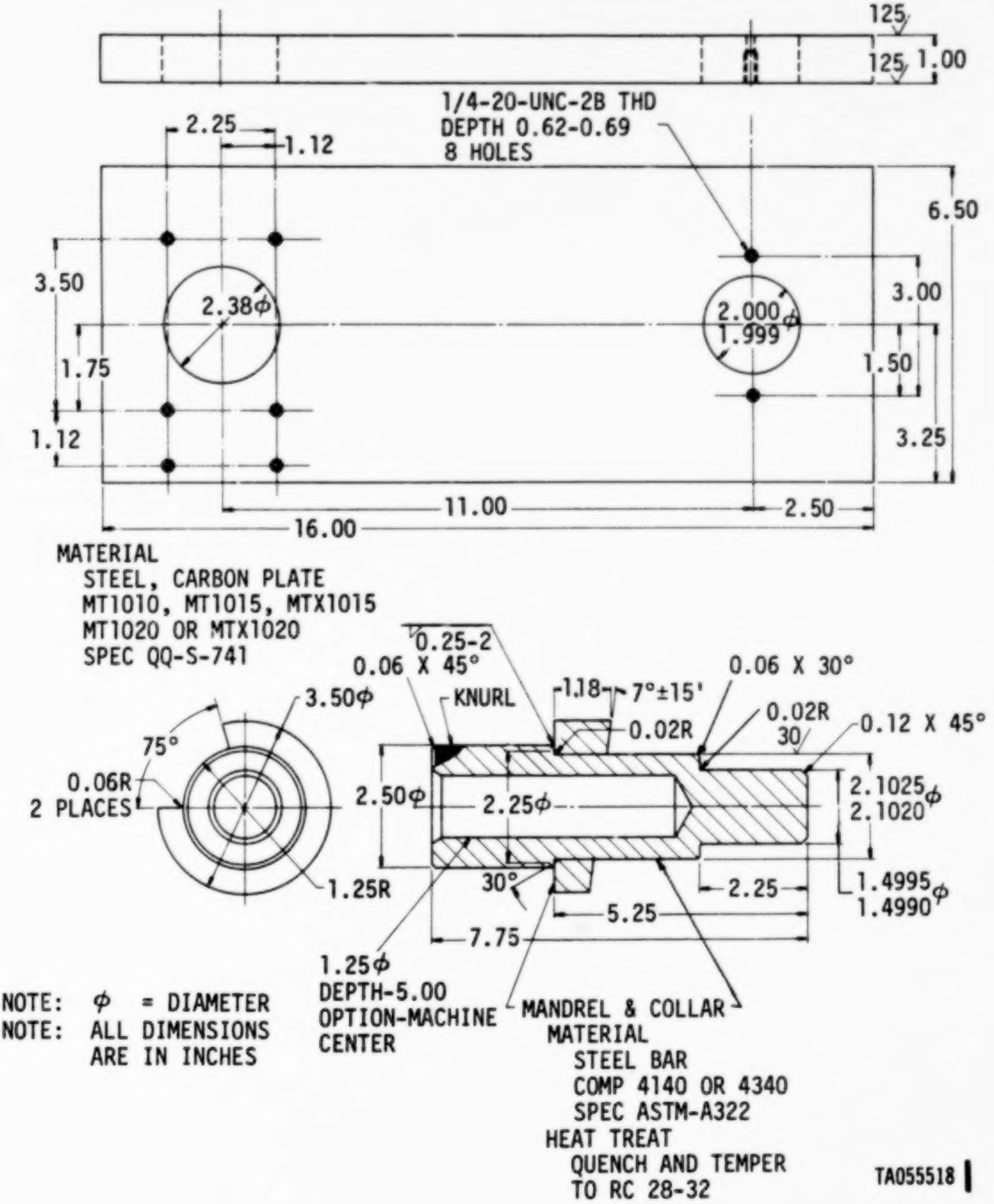

A
A
GUIDE ASSEMBLY
SEE FIGURE 2-1.4
8 - SCREW - MS16995-50
MANDREL ASSEMBLY
SEE FIGURE 2-1.3
SLEEVE
SEE FIGURE 2-1.4
GUIDE
SEE FIGURE 2-1.2
BLOCK
SEE FIGURE 2-1.5
LOCATOR
SEE FIGURE 2-1.5
PLATE
SEE FIGURE 2-1.3
SECTION A-A
-A-
2.12
30
0.25
15°
1.501
1.500 ϕ
30
2.2490
2.2485 ϕ
.03 X 45°
2 PLACES
↗ A 0.002
TOTAL
INSTALLATION GUIDE
-A-
2.12
30
0.25
15°
1.501
1.500 ϕ
30
2.1270
2.1265 ϕ
0.03 x 45°
2 PLACES
↗ A 0.002
TOTAL
REMOVER GUIDE
TA055517

NOTE: ϕ = DIAMETER

NOTE: ALL DIMENSIONS
ARE IN INCHES

MATERIAL
STEEL, ALLOY TUBING
SEAMLESS OR WELDED
COMP 4140 OR 4340
SPEC ASTM-A519
HEAT TREAT
QUENCH AND TEMPER
TO RC 28-34

Figure 2-1.2. Improvised tool, fixture and guides.


125
125
1.00
1/4-20-UNC-2B THD
DEPTH 0.62-0.69
8 HOLES
2.25
1.12
6.50
3.50
2.38ϕ
2.000
1.999ϕ
3.00
1.75
1.50
1.12
3.25
11.00
2.50
16.00
0.25-2
0.06 X 45°
KNURL
1.18
7°±15'
0.02R
0.06 X 30°
0.02R
30
0.12 X 45°
3.50ϕ
75°
0.06R
2 PLACES
2.50ϕ
2.25ϕ
2.1025
2.1020ϕ
1.25R
30°
2.25
1.4995
1.4990ϕ
5.25
7.75
TA055518

MATERIAL
STEEL, CARBON PLATE
MT1010, MT1015, MTX1015
MT1020 OR MTX1020
SPEC QQ-S-741

1.25ϕ
DEPTH-5.00
OPTION-MACHINE
CENTER

MANDREL & COLLAR
MATERIAL
STEEL BAR
COMP 4140 OR 4340
SPEC ASTM-A322
HEAT TREAT
QUENCH AND TEMPER
TO RC 28-32

NOTE: ϕ = DIAMETER
NOTE: ALL DIMENSIONS ARE IN INCHES

Figure 2-1.3. Improvised tool, plate and mandrel assembly.

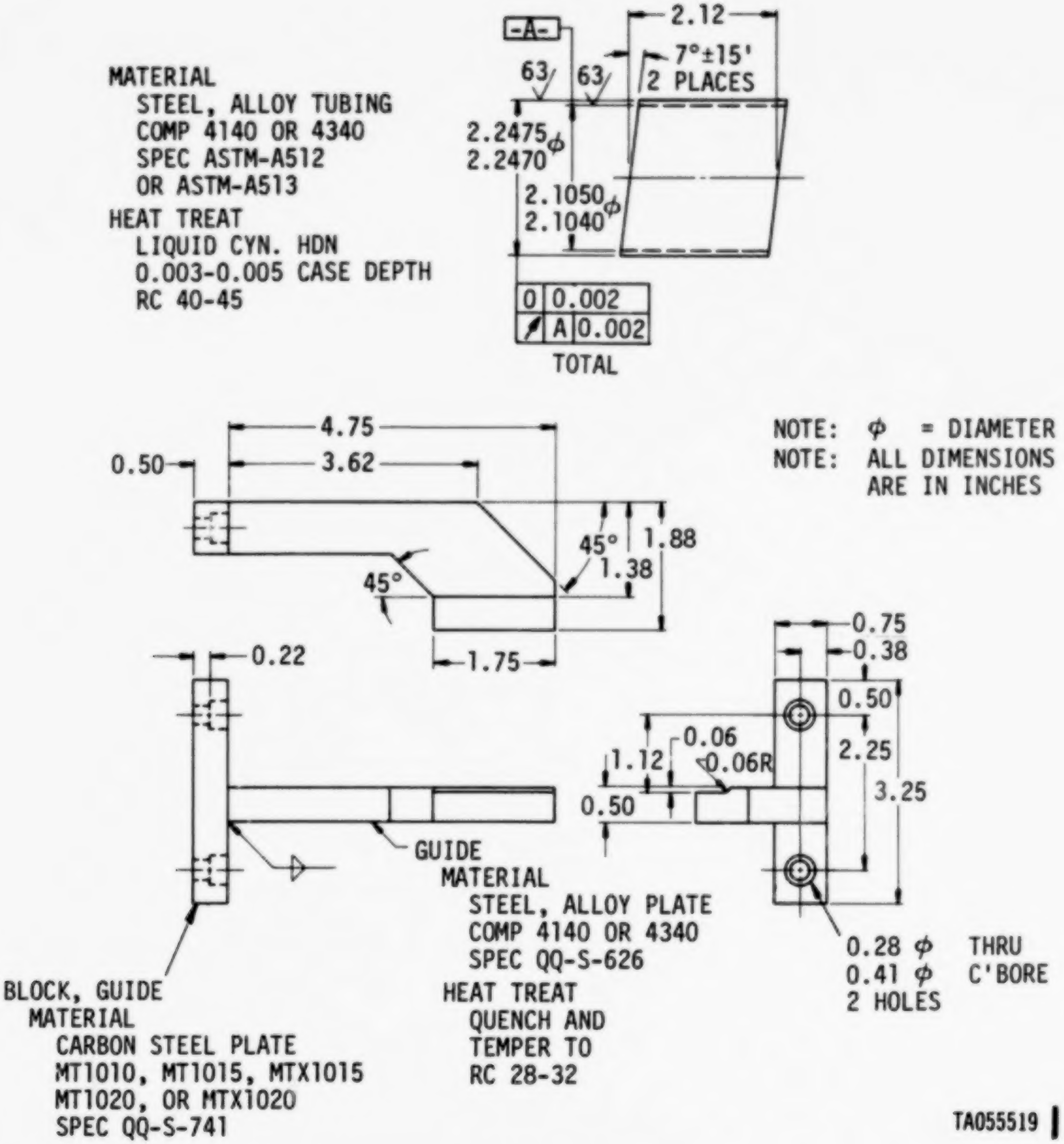
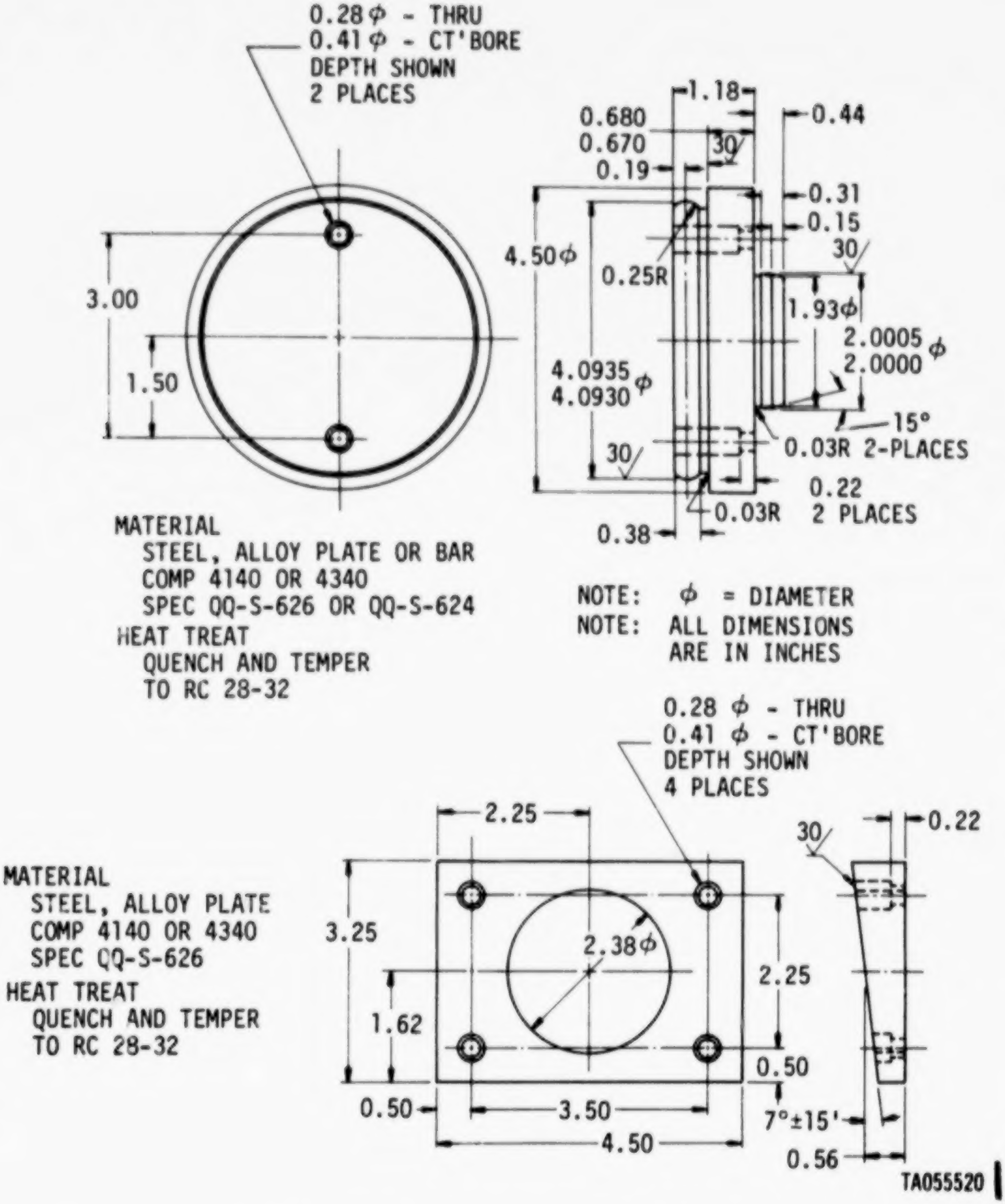

MATERIAL
STEEL, ALLOY TUBING
COMP 4140 OR 4340
SPEC ASTM-A512
OR ASTM-A513
HEAT TREAT
LIQUID CYN. HDN
0.003-0.005 CASE DEPTH
RC 40-45
-A-
63
63
2.12
7°±15'
2 PLACES
2.2475 φ
2.2470
2.1050 φ
2.1040
0 | 0.002
⌰ | A | 0.002
TOTAL
4.75
0.50
3.62
45°
1.88
1.38
45°
1.75
NOTE: φ = DIAMETER
NOTE: ALL DIMENSIONS ARE IN INCHES
0.22
0.75
0.38
0.50
0.06
0.06R
1.12
2.25
3.25
0.50
GUIDE
MATERIAL
STEEL, ALLOY PLATE
COMP 4140 OR 4340
SPEC QQ-S-626
HEAT TREAT
QUENCH AND
TEMPER TO
RC 28-32
0.28 φ THRU
0.41 φ C'BORE
2 HOLES
BLOCK, GUIDE
MATERIAL
CARBON STEEL PLATE
MT1010, MT1015, MTX1015
MT1020, OR MTX1020
SPEC QQ-S-741
TA055519

Figure 2-14. Improvised tool, sleeve and guide.


0.28 ϕ - THRU
0.41 ϕ - CT'BORE
DEPTH SHOWN
2 PLACES
3.00
1.50
1.18
0.680
0.670
0.19
0.44
30
4.50ϕ
0.25R
0.31
0.15
30
1.93ϕ
2.0005
2.0000 ϕ
4.0935
4.0930 ϕ
15°
30
0.03R 2-PLACES
0.03R
0.22
2 PLACES
0.38
0.28 ϕ - THRU
0.41 ϕ - CT'BORE
DEPTH SHOWN
4 PLACES
2.25
30
0.22
3.25
2.38ϕ
2.25
1.62
0.50
0.50
3.50
4.50
7°±15'
0.56
TA055520

MATERIAL
STEEL, ALLOY PLATE OR BAR
COMP 4140 OR 4340
SPEC QQ-S-626 OR QQ-S-624
HEAT TREAT
QUENCH AND TEMPER
TO RC 28-32

NOTE: ϕ = DIAMETER
NOTE: ALL DIMENSIONS ARE IN INCHES

MATERIAL
STEEL, ALLOY PLATE
COMP 4140 OR 4340
SPEC QQ-S-626
HEAT TREAT
QUENCH AND TEMPER
TO RC 28-32

Figure 2-1.5. Improvised tool, locator and block.

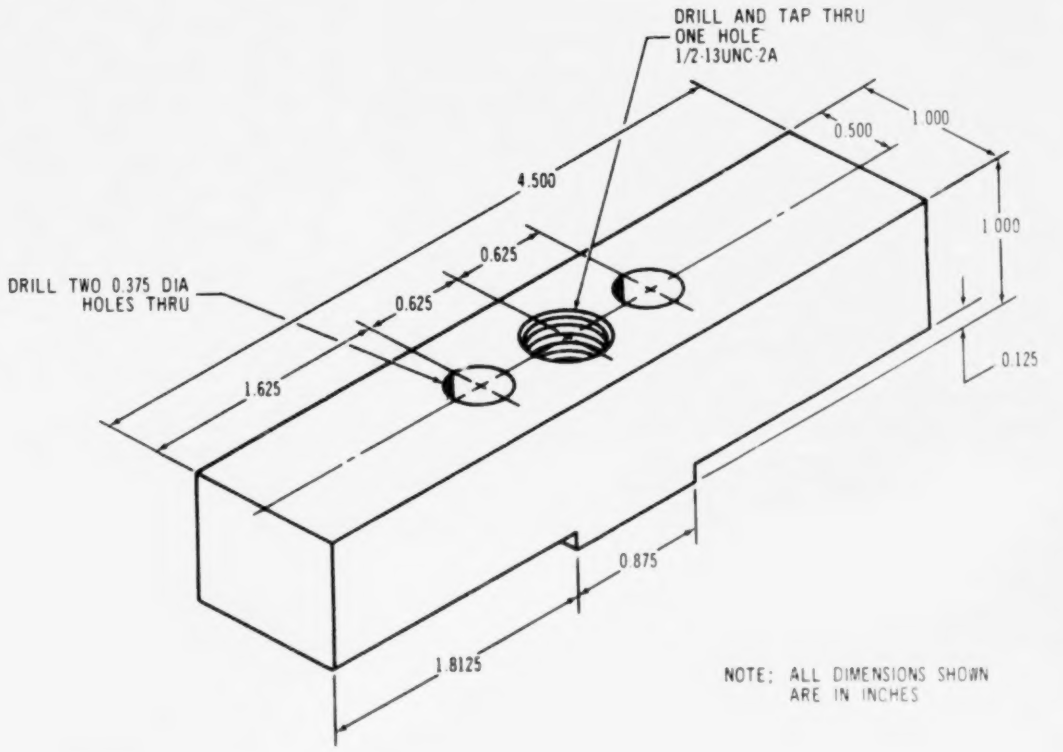

DRILL AND TAP THRU
ONE HOLE
1/2-13UNC-2A
1.000
0.500
4.500
1.000
0.625
DRILL TWO 0.375 DIA
HOLES THRU
0.625
0.125
1.625
0.875
1.8125
NOTE: ALL DIMENSIONS SHOWN
ARE IN INCHES
MATERIAL:
4-1/2 X 1 X 1 CARBON TOOL STEEL
ONE 1/2-13UNC-2A X 2. HEX-HD CAP SCREW
TWO 5/16-13UNF-2A X 2-1/2 HEX-HD CAP SCREW
TA021540

Figure 2-2. Improvised tool, coupling puller.

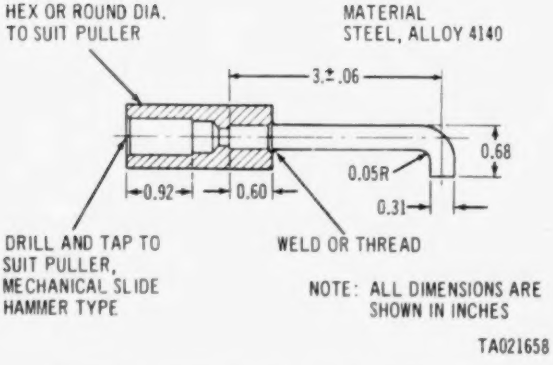

HEX OR ROUND DIA.
TO SUIT PULLER
MATERIAL
STEEL, ALLOY 4140
3.±.06
0.68
0.05R
0.92
0.60
0.31
DRILL AND TAP TO
SUIT PULLER,
MECHANICAL SLIDE
HAMMER TYPE
WELD OR THREAD
NOTE: ALL DIMENSIONS ARE
SHOWN IN INCHES
TA021658

Figure 2-3. Improvised tool, valve sleeve remover.

Figure 2-4 deleted.

Table 2-1. Special Tools and Equipment for Direct Support and General Support

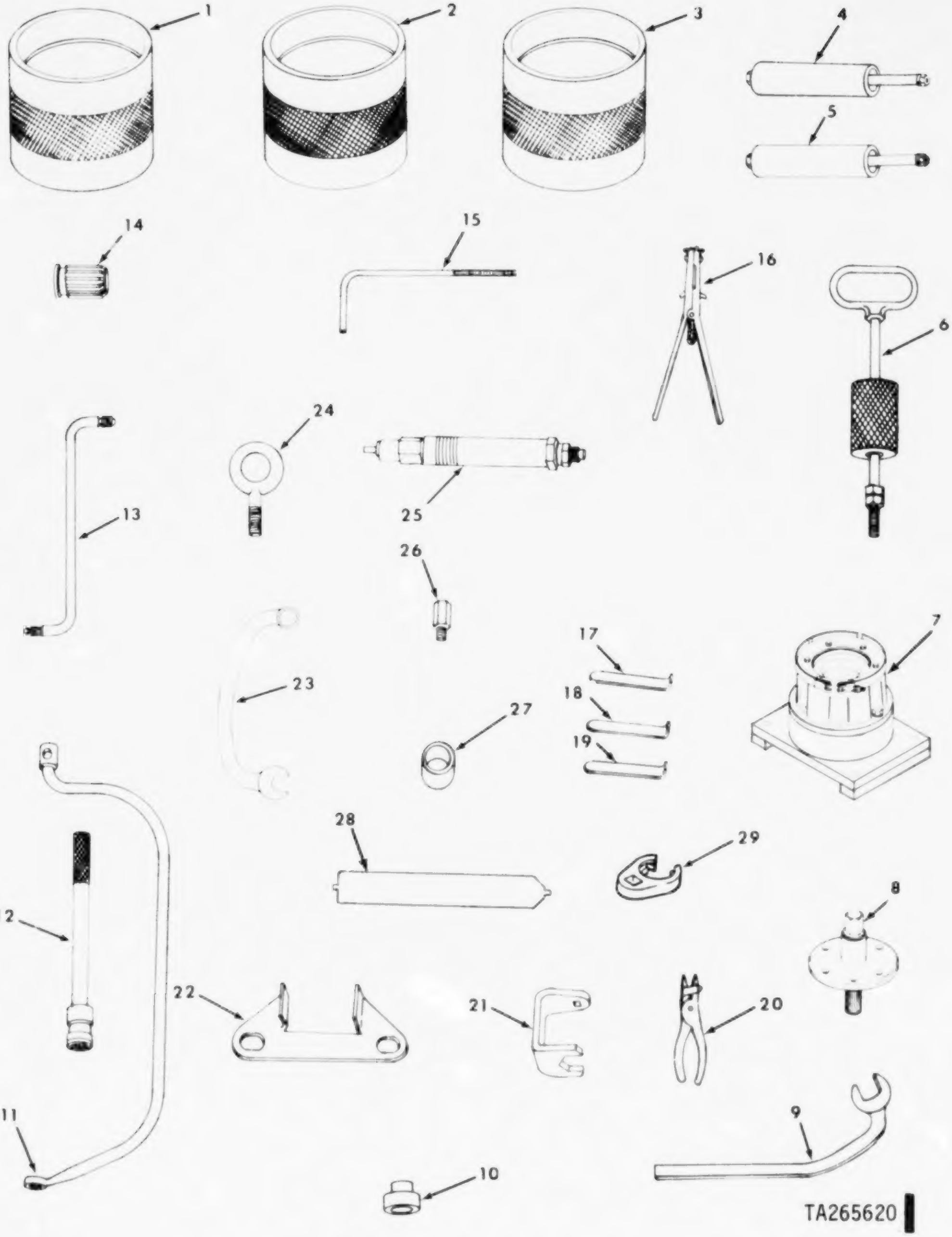
Item	Identifying No.	Reference		Use	Fig.	Item
		Fig.	Para.			
ADAPTER, COMPRESSION: Compression Test	8743025	2-149	2-51	Used with GAGE 10899180 to check cylinder compression	2-5	25
ADAPTER, MECHANICAL: 1/2-20NF-2 to 1/2-13NC x 1-7/8 in. long	8375091	3-130 3-138	3-33 3-34	Used with PULLER 8708712 to remove starter and generator idler gearshaft and with SPREADING TOOL 8708361 to remove main bearing caps	2-5	26
ALINEMENT TOOL: Fuel Pump Drive Housing (Model AVDS-1790-2 DR)	12275768	2-148.4	2-49.1	Used to aline fuel pump drive housing, late engines	2-6	22
ALINEMENT TOOL: Fuel Pump Drive Housing (Model AVDS-1790-2 DR)	11684212	2-148.4	2-49.1	Used to aline fuel pump drive housing, early engines	2-6	21
BLADE, THICKNESS GAGE: 0.010 in. Intake Valve Clearance	10882615	2-154 3-326	2-52 3-168	Intake valve tappet adjusting, 0.010 in. gap	2-5	17
BLADE, THICKNESS GAGE: 0.025 in. Exhaust Valve Clearance	10882616	2-153 3-327	2-52 3-168	Exhaust valve tappet adjusting, 0.025 in. gap	2-5	18
BLADE, THICKNESS GAGE: 0.100 in. Intake Valve Timing Clearance	10882617	2-157 3-326	2-53 3-168	Valve tappet adjusting, 0.100 in. gap	2-5	19
BOLT, EYE: 1-3/8 id x 2-1/2 od x 4-23/32 in. long, 5/8-11 Thread	MS51937-7	2-98 3-118 3-315	2-32 3-32 3-162	Lifting flywheel	2-5	24
BUSHING, REAMER: Exhaust Valve	11642089			Used with REAMERS 7083696 and 7083697 to ream exhaust valve guide hole	2-6	9
BUSHING, REAMER: Intake Valve	11642088	3-198	3-72	Used with REAMERS 7083699 and 7083698 to ream intake valve guide hole	2-6	10
COMPRESSOR: Piston Ring, Standard	10882888	3-318	3-164	Installing standard pistons and rings in cylinders	2-5	1
COMPRESSOR: Piston Ring, 0.010 and 0.020 in. Oversize	10882888-1			Installing 0.010 or 0.020 in. oversize pistons and rings in cylinders	2-5	2
COMPRESSOR: Piston Ring, 0.030 and 0.040 in. Oversize	10882888-2			Installing 0.030 or 0.040 in. oversize pistons and rings in cylinders	2-5	3
CROWFOOT, ATTACHMENT: Fuel Injector Nozzle Holder	12254244	2-85	2-30	Removing or installing fuel injector nozzle holders	2-5	21
CROWFOOT, ATTACHMENT	FRH-240S	2-38	2-21	Removing fuel injection tube nut from nozzle	2-5	29
CUTTER, CARBON, NOZZLE: Nozzle Seat	10882949	3-189	3-70	Cleaning carbon from fuel injector nozzle holder seat in cylinder head	2-5	12
EXTRACTOR, SCREW THREAD: No. 10 thru 3/8 in.	MIL-T-21309			Removing threaded inserts	2-6	24
EXTRACTOR, SCREW THREAD: 7/16 to 1 in.	7751056	3-142	3-39	Removing threaded inserts	2-6	23
GAGE ASSEMBLY: Compression Testing	10899180	2-150	2-51	Used with ADAPTER 8743025 to check cylinder compression	2-7	10
GAGE, PISTON RING: Piston Top Ring Groove	12254296	3-183.1	3-65	Checking piston ring top groove	2-5	28
GAGE, RING PLAIN: Piston Ring, Standard and 0.020 in. Oversize	10912589	3-185	3-65	Checking piston ring gap	2-7	6
GAGE: Piston Ring, 0.010 and 0.030 in. Oversize	10912589-1			Checking 0.010 or 0.030 in. oversize piston ring gap	2-7	7
GAGE: Piston Ring, Standard and 0.040 in. Oversize	10912589-2			Checking std or 0.040 in oversize piston ring gap	2-7	8
HOLDING BAR AND PULLER ASSEMBLY: Power Take-off (Model AVDS-1790-2DR)	12254282	2-148.2	2-49.1	Power take-off coupling	2-6	19
HOLDING TOOL, GENERATOR: Generator Drive Gear Coupling (Model AVDS-1790-2C)	11684166	3-163.1	3-51	Checking generator drive gear coupling torque	2-5	7
INSERTER, SCREW THREAD: 5/16-24 Thread	MIL-T-21309	3-143	3-39	Installing threaded inserts	2-6	3
INSERTER, SCREW THREAD: 3/8-24 Thread	8375324			Installing threaded inserts	2-6	4
INSERTER, SCREW THREAD: 7/16-20 Thread	MIL-T-21309			Installing threaded inserts	2-6	5

Table 2-1. Special Tools and Equipment for Direct Support and General Support – Continued

Item	Identifying No.	Reference		Use	Fig.	Item
		Fig.	Para.			
INSERTER, SCREW THREAD: 1/2-13 Thread	3551-8			Installing threaded inserts	2-6	7
INSERTER, SCREW THREAD: 1/2-20 Thread	8761582			Installing threaded inserts	2-6	6
LIFTER ASSEMBLY, VALVE: Valve Springs	8761535	3-186 3-200	3-69 3-73	Used with STAND 8708419 for removing and installing valves and valve springs	2-7	5
PLIERS, RETAINING RING: Fan Drive Shaft	GGG-P-480A-Type 2, Class 3, Style B, Size 22	3-78	3-25 3-167	Removing or installing inner fan drive shaft retaining ring	2-5	20
PROTECTOR, CRANKCASE: Cylinder Mounting Pads	10882790	3-106 3-136	3-28 3-34	Protecting crankcase at cylinder removal	2-5	22
PULLER ASSEMBLY: Fuel Injection Nozzle	12275805	2-85.1	2-30	Removing fuel injector nozzles	2-6	18
PULLER, MECHANICAL: "T" Handle, 3/4-16UNF-2A 6-1/2 in. long	8761297	2-162 3-72 3-73	2-53 3-24 3-24	Removing and installing camshaft drive shaft and upper gear oil transfer plug	2-6	8
PULLER, MECHANICAL: Slide Hammer, 10¾ in. long with ½-20UNF-2A Thread	8708712	3-130 3-138	3-33 3-34	Used with ADAPTER 8375091 to remove starter and generator drive idler gearshaft and with SPREADING TOOL 8708361 to remove main bearing caps	2-5	6
PULLER, MECHANICAL: Exhaust Valve Guide	10882954			Removing exhaust valve guides	2-5	4
PULLER, MECHANICAL: Intake Valve Guide	10882953	3-194	3-72	Removing intake valve guides	2-5	5
PULLER, MECHANICAL: Threaded, 5/16-18UNC-2, 8-1/2 in. long, 2-3/4 in. Handle (3 required per operation)	5379997	2-101 3-111 3-208	2-32 3-30 3-86	Removing fan drive oil seal retainer, vibration damper, and crankshaft oil seal housing	2-5	15
REAMER, HAND: Roughing, Exhaust Valve Stem Hole. Diameter tapers from 0.550 to 0.560 in., 13-3/4 in. long	7083696			Used with BUSHING 11642089 for rough reaming exhaust valve guide hole	2-6	14
REAMER, HAND: Finishing Exhaust Valve Stem Hole. Diameter tapers from 0.557 to 0.562 in., 13-3/4 in. long	7083697			Used with BUSHING 11642089 for finish reaming exhaust valve guide holes	2-6	15
REAMER, HAND: Roughing Intake Valve Stem Hole. Diameter tapers from 0.488 to 0.498 in., 13-3/4 in. long	7083698	3-198	3-72	Used with BUSHING 11642088 for rough reaming intake valve guide holes	2-6	16
REAMER, HAND: Finishing Intake Valve Stem Hole. Diameter tapers from 0.495 to 0.500 in., 13-3/4 in. long	7083699	3-198	3-72	Used with BUSHING 11642088 for finish reaming intake valve guide hole	2-6	17
REMOVER AND REPLACER: Plier Type	7950177	3-181	3-63	Removing and installing piston rings	2-5	16
REPLACER, VALVE GUIDE: Intake Valve	10883052	3-195	3-72	Installing intake valve guide	2-6	11
REPLACER, VALVE GUIDE: Exhaust Valve	10883053			Installing exhaust valve guide	2-6	12
SLING, CRANKSHAFT AND CONNECTING ROD: Removing or Installing	10882958	3-132 3-133 3-134	3-33 3-33 3-33	Removing and installing engine crankshaft	2-7	1
SLING, ENGINE LIFTING, BEAM-TYPE: Multiple Leg (Model AVDS-1790-2DR)	11671664			Engine lifting	2-8	1
SLING, FAN DRIVE AND ADVANCE UNIT HOUSING: Removing or Installing	10882945	3-90	3-26	Removing and installing rear fan and advance unit housing	2-7	11

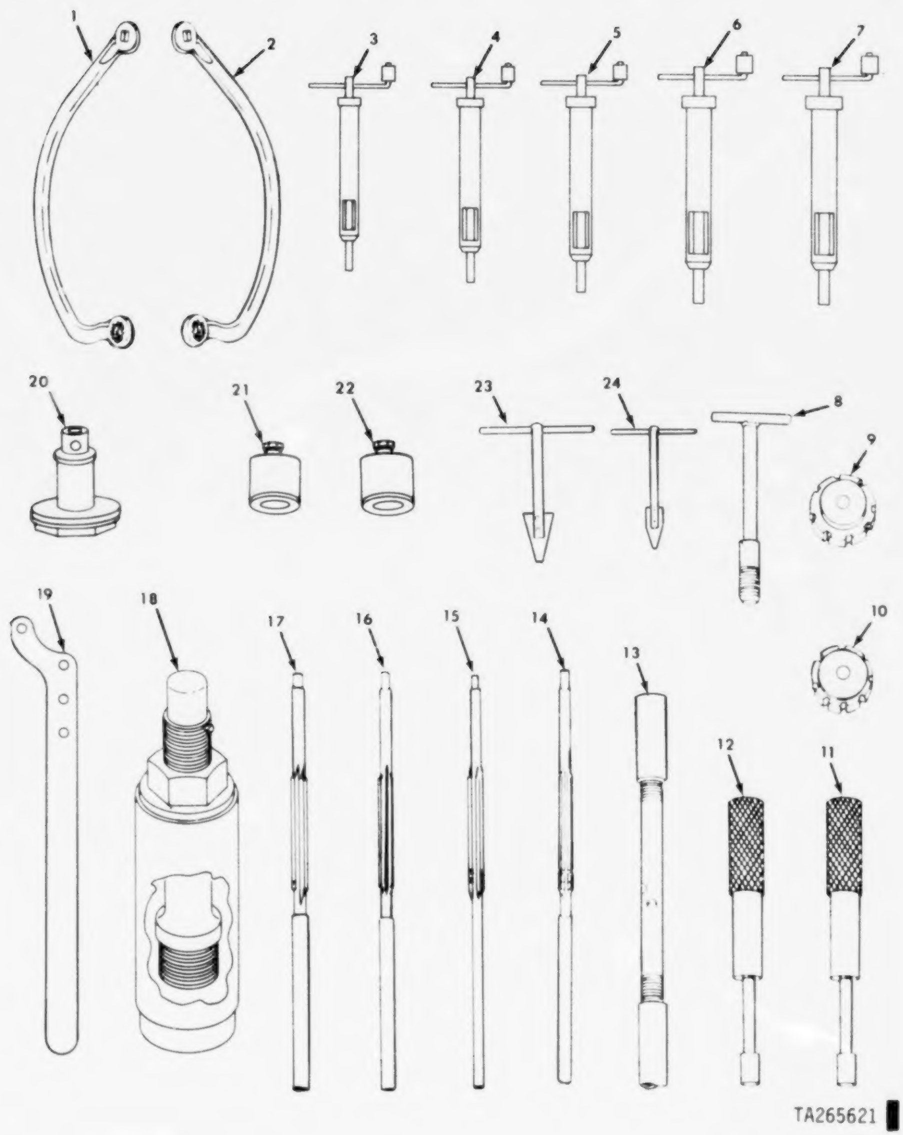
Table 2-1. Special Tools and Equipment for Direct Support and General Support – Continued

Item	Identifying No.	Reference		Use	Fig.	Item
		Fig.	Para.			
SLING, MULTIPLE LEG: Engine Lifting (Models AVDS-1790-2C and AVDS-1790-2D)	12257229	3-1	3-2	Engine lifting	2-8	3
SOCKET, SOCKET WRENCH: Final Filter Cap	12251213	2-69.1	2-26.1	Removing fuel injection pump final filter cap	2-6	20
SOCKET WRENCH: Fuel Injector Nozzle Holder, 1-3/8 in. nom. hex socket, 3/4 in. sq. drive, 2 in. long	11610171			Removing fuel injector nozzle holders	2-5	10
SPACER, FAN ROTOR HUB SLEEVE: Leak Test	10882651	2-60 3-336	2-21 3-189	Retains fan clutch oil seal during fuel injection pump leak test	2-5	27
SPREADING TOOL, CRANKCASE: Bearing Cap Removing or Installing	8708361	3-130 3-309	3-33 3-161	Used with PULLER 8708712 and ADAPTER 8375091 to remove main bearing caps	2-6	13
STAND, MAINTENANCE AND OVERHAUL: Engine	10912260	3-5	3-5	Engine overhaul	2-8	2
STAND, VALVE REMOVING AND INSERTING: Cylinder Valves	8708419	3-186 3-187 3-200	3-69 3-69 3-73	Cylinder stand for removing and installing valves, used with LIFTER 8761535	2-7	9
STONE AND HOLDER ASSEMBLY: Cylinder hone composed of:	5704380			Honing cylinder bores	2-7	2
150 grain stone	11662775-2					
180 grain stone	11662775-1					
GAGE, FAN ROTOR: checking erosion	12275775	3-262.1	3-112	Checking leading edge of fan rotor for erosion	2-7	12
TEST STAND: Advance Unit	10898928	3-248	3-99	Test fuel injection pump advance unit	2-8	4
TOOL, GENERATOR, COUPLING, TORQUE TEST: Generator Drive Gear Coupling (Model AVDS-1790-2C)	11684153	2-15.1 3-163.1	2-19 3-51	Torque testing generator drive gear coupling	2-5	8
TUBE, ATTACHING NOZZLE: Connector	10882963	2-132	2-48	Check fuel injector nozzles	2-5	13
WRENCH, OPEN END: Starter Mounting Nuts, 15/16 in. opening, offset handle, 10 in. long	8761568	2-12	2-18	Removing or installing starter mounting nuts	2-5	9
WRENCH, SPLINED: Engine Turning, 3/4 in. drive with external spline, 2-1/2 in. long (Models AVDS-1790-2C and AVDS-1790-2D).	10882747	2-42 3-325	2-21 2-30 3-22 3-24 3-168	Turning engine at transmission drive gearshaft	2-5	14
WRENCH, BOX: Torquing Cylinder Hold Down Nuts, 1/2 in. drive, 5/8 in. double hex, 21-3/8 in. long	8761562	3-102	3-28	Torquing cylinder hold down nuts	2-5	11
WRENCH, BOX: Torquing Cylinder Hold Down Nuts	11684130-1			Torquing No. 1 left and right cylinder hold down nuts	2-6	1
WRENCH, BOX: Torquing Cylinder Hold Down Nuts	11684130-2			Torquing No. 1 left and right cylinder hold down nuts	2-6	2
WRENCH, BOX AND OPEN END COMBINATION: Generator Mounting Nuts (Models AVDS-1790-2D and AVDS-1790-2DR)	10935476	2-22	2-19	Removing and installing generator mounting nuts	2-5	23



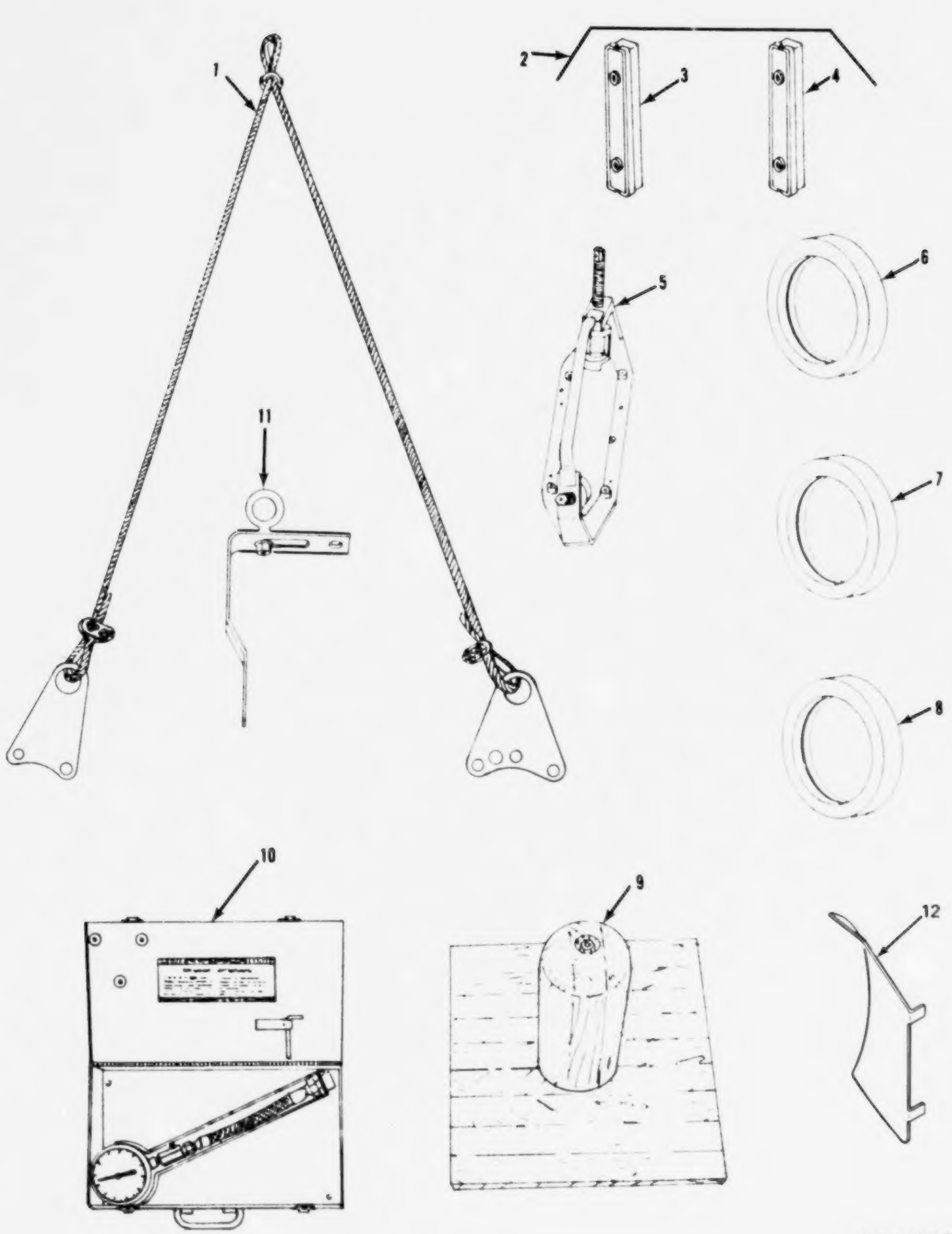
1 Compressor
2 Compressor
3 Compressor
4 Mechanical puller
5 Mechanical puller
6 Mechanical puller
7 Generator holding tool
8 Generator coupling tool
9 Open end wrench
10 Socket wrench
11 Box wrench
12 Nozzle carbon cutter
13 Attaching nozzle tube
14 Splined wrench
15 Mechanical puller
16 Remover and replacer
17 Thickness gage blade
18 Thickness gage blade
19 Thickness gage blade
20 Retaining ring pliers
21 Attachment crowfoot
22 Crankcase protector
23 Box and open end combination wrench
24 Eye bolt
25 Compression adapter
26 Mechanical adapter
27 Fan rotor hub sleeve spacer
28 Piston ring gage
29 Attachment crowfoot

Figure 2-5. Special tools.



1 Box wrench
2 Box wrench
3 Screw thread inserter
4 Screw thread inserter
5 Screw thread inserter
6 Screw thread inserter
7 Screw thread inserter
8 Mechanical puller
9 Reamer bushing
10 Reamer bushing
11 Valve guide replacer
12 Valve guide replacer
13 Crankcase spreading tool
14 Hand reamer
15 Hand reamer
16 Hand reamer
17 Hand reamer
18 Puller assembly, fuel injection nozzle
19 Holding bar and puller assembly
20 Socket wrench socket
21 Alinement tool, early engines
22 Alinement tool, late engines
23 Screw thread extractor
24 Screw thread extractor

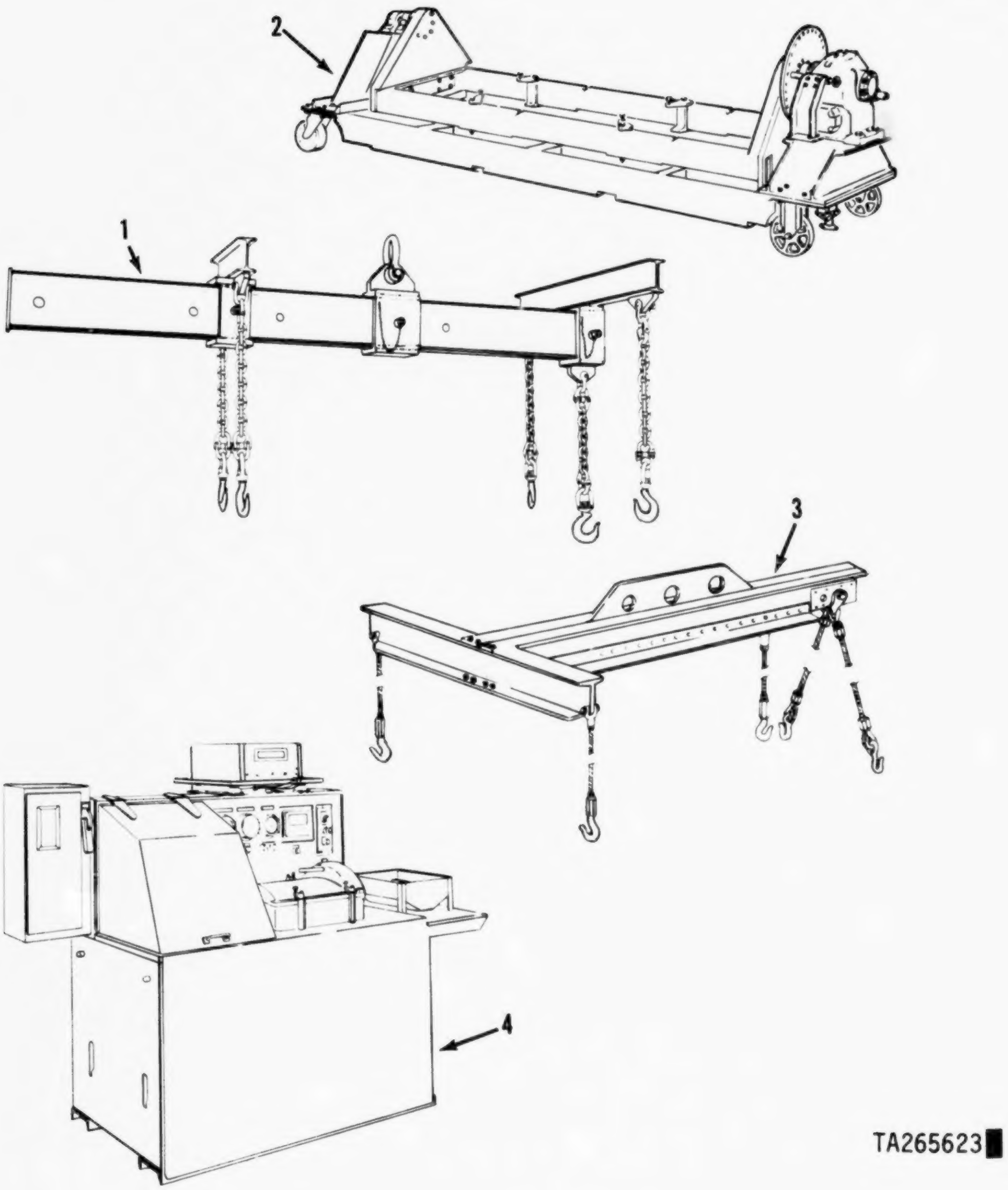
Figure 2-6. Special tools.



TA265622

1 Crankshaft and connecting rod sling
2 Stone and holder assembly
3 150 grain stone
4 180 grain stone
5 Valve lifter assembly
6 Plain ring gage
7 Gage
8 Gage
9 Valve removing and inserting stand
10 Gage assembly
11 Fan drive and advance unit housing sling
12 Fan rotor gage

Figure 2-7. Special tools.



1 Multiple leg sling
2 Maintenance and overhaul stand
3 Beam-type engine lifting sling
4 Test stand

Figure 2-8. Special tools.

Section II. TROUBLESHOOTING

2-7. Purpose of Troubleshooting

Information in this chapter is for use of Direct Support and General Support maintenance personnel. It provides the instructions to supporting maintenance personnel for corrective action.

a. Prevent Damage. Operation of a malfunctioning or deadlined vehicle or engine without a preliminary examination can cause further damage to the engine and possible injury to personnel. By careful inspection and troubleshooting, such damage and injury can be avoided. In addition, the cause of faulty operation can often be determined without extensive disassembly.

b. Precautions by Inspection. The inspections are to be performed before attempting to operate the vehicle. These inspections are mainly to determine the condition and to take precautions to prevent further damage.

c. Troubleshooting While Mounted. The troubleshooting performed while the engine is mounted in the vehicle is included in this troubleshooting section. The procedures for troubleshooting vehicle components and systems related to engine operation are also included.

d. Troubleshooting Engine Only. If the engine only is received, inspection should be performed to verify the diagnosis made while the engine was installed in the vehicle. This inspection, to uncover further defects or to determine malfunction, is important as it is the only means for determining the trouble without completely disassembling the engine.

2-8. General Instructions

This chapter contains inspection and troubleshooting procedures to be performed while a malfunctioning engine is still mounted in the vehicle and after it has been removed. Those procedures which apply only with the engine or power pack removed from the vehicle are indicated with the symbol*. The procedures are presented in paragraph 2-9, Troubleshooting Procedures, and paragraph 2-10, Diagnostic Tests. Troubleshooting procedures for the clean air package for the models AVDS-1790-2CA, and AVDS-1790-2DA are presented in Chapter 4.

2-9. Troubleshooting Procedures

A table of contents is provided for this section. When a malfunction occurs, it can be related to a specific engine, component or engine system abnormal operation. The index is so classified to assist in locating the appropriate troubleshooting item. Probable causes are listed for each item. The causes are listed in order of most frequent occurrence or in logical sequence for ease and time of accomplishment.

Corrective actions are listed for each probable cause. The actions are in logical sequence for accomplishment. When detailed instructions are required to accomplish the corrective action, references are made to the appropriate technical manual. When diagnostic testing is necessary before final corrective action can be determined, reference is made to the appropriate diagnostic tests in table 2-3.

2-10. Diagnostic Tests

This section contains diagnostic test descriptions which are referenced in table 2-2, Troubleshooting Procedures. These tests provide analysis for the purpose of determining further corrective action required to eliminate a malfunction. A table of contents is provided to assist in locating the required diagnostic test.

Troubleshooting Procedures
Contents for table 2-2

Item No. *Malfunction*
1. Engine Fails to Crank
    1-1 Engine will not crank:
    1-2 Starter engages but engine does not crank:
    1-3 Starter drive spins, but engine does not crank:
2. Engine Cranks Too Slow
    2-1 Cranking speed too slow for starting:
3. Engine Fails to Start At Normal Cranking Speed
    3.1 Cylinders not firing:
    3-2 Cylinders partially firing:
4. Engine Low Idle Abnormal Operation
    4-1 Low idle speed too low:
    4-2 Low idle speed erratic:
    4-3 Misfires at idle:
5. Engine High Idle (No Load) Abnormal Operation
    5-1 High idle speed too low:
    5-2 High idle speed too high:

6. Engine Overspeeds
    - 6.1 Overspeeds during vehicle operation:
    - 6.2 Engine speed excessive with accelerator pedal released:
7. Engine Stops During Operation
    - 7.1 Stops gradually with loss of power and speed:
    - 7.2 Stops suddenly:
8. Engine Fails to Shut Down
    - 8.1 Fails to stop with electric fuel shut-off:
    - 8.2 Fails to stop with manual fuel shut-off:
    - 8.3 Fails to stop when vehicle fuel supply is shut-off:
9. Engine Rough Operation
    - 9.1 Misfires:
    - 9.2 Vibration or roughness:
10. Noisy Operation
    - 10.1 Knock or tapping sound:
    - 10.2 Diesel knock:
    - 10.3 Grinding or squeaking sound:
11. Abnormal Exhaust Conditions
    - 11.1 Excessive black smoke:
    - 11.2 Excessive bluish smoke during vehicle operation:
    - 11.3 White (greyish) smoke during low idle operation:
    - 11.4 Oily and/or heavy carbon deposits on vehicle rear grille:
12. Cooling System Deficiencies
    - 12.1 Engine overheating:

Troubleshooting Procedures–Continued
Contents for table 2-2

Item No. *Malfunction*

13. Abnormal Oil Conditions
    - 13.1 Low oil pressure–temperature normal:
    - 13.2 Low oil pressure:
    - 13.3 High oil temperature:
    - 13.4 Low oil level:
    - 13.5 High oil level:
    - 13.6 Oil diluted with fuel:
    - 13.7 Excessive oil consumption:
    - 13.8 Excessive crankcase blowby:
    - 13.9 Generator oil pressure abnormal: (AVDS-1790-2C and AVDS-1790-2CA)
14. Fuel System Abnormal Conditions
    - 14.1 Air in system:
    - 14.2 Water contaminated fuel:
    - 14.3 Accelerator and throttle linkage deficiencies:
    - 14.4 In-tank fuel pump deficiencies:
    - 14.5 Fuel filter restriction:
    - 14.6 Fuel injection pump deficiencies:
    - 14.7 Engine fuel supply pump defective:
    - 14.8 Fuel injector nozzle defective:
    - 14.9 Fuel injector tube high pressure fuel leakage:
    - 14.10 Fuel injection pump pressure regulating valve fuel return valve defective:
    - 14.11 Engine fuel return restriction:
    - 14.12 Fuel return check valve defective:
    - 14.13 Automatic water drain system inoperative:
    - 14.14 Deleted
15. Generator Abnormal Operation
    - 15.1 Not charging:
    - 15.2 Undercharging:
    - 15.3 Overcharging:
    - 15.4 Discharging:
    - 15.5 Erratic charging:
16. Intake Manifold Heater Abnormal Operation
    - 16.1 Heater inoperative:
17. Vehicle Air Cleaner Blower Inoperative
    - 17.1 Motor inoperative:
18. Engine Time Totalizing Meter
    - 18.1 Totalizing meter inoperative:
19. Low Power Investigation
    - 19.1 Preliminary investigation:
    - 19.2 Power verification:
    - 19.3 Low stall with both banks firing, and normal smoke:
    - 19.4 Low stall speed with black exhaust smoke:
    - 19.5 Low stall with excess bluish exhaust smoke:
    - 19.6 Low stall with one bank not firing:
20. Engine Internal Damage
    - 20.1 Engine will not rotate, or rotates with binding, grinding or squealing noise:
21. Smoke Generating System Abnormal Operation
    - 21.1 Engine fails to produce smoke when engine is operating and smoke generating system is activated.
    - 21.2 Smoke produced is of poor quality.
    - 21.3 Smoke produced when smoke generating system is not activated.

Table 2-2. Troubleshooting Procedures

Malfunction	Probable cause	Corrective action
1. Engine Fails to Crank		
1.1 Engine will not crank: (No response when starter switch is pressed.)	a. Master switch "OFF." b. Transmission shift selector not in "neutral/park" position.	a. Turn switch "ON." b. Place shift selector in "neutral/park" position.

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
Engine Fails to Crank — Continued		
	c. Transmission shift linkage and "neutral/park" position adjustment improper.	c1. Adjust transmission shift linkage. Refer to pertinent vehicle technical manual.
		c2. Adjust "neutral/park" switch for full travel. Refer to pertinent vehicle technical manual.
	d. Low voltage protection module operating or batteries discharged. (below 12 volts)	d1. Check panel lights for "ON" and battery indicator. Refer to DT 13.1 and 13.2
	NOTE Low voltage protection module prevents starter operation below 12 volts.	d2. Check battery condition, loose, broken or corroded cables and terminals. Refer to pertinent vehicle technical manual.
		d3. Recharge or replace batteries; or "slave" start engine. Repair or replace defective cables and terminals.
		d4. Check generator operation after starting engine. Refer to DT 13.3.
	e. Electrical starting circuit defective.	e1. Check circuits, switches and connectors. Refer to pertinent vehicle technical manual.
		e2. *Replace starter low voltage protective module (para 2-45)
1.2 Starter engages but engine does not crank: (Audible solenoid action or starter gear engagement.)	a. Starter engagement assembly damaged.	a1. *Remove starter and inspect assembly (para 2-18) Refer to pertinent starter manual. Repair or replace starter.
		a2. *Install starter assembly (para 2-18).
	b. Starter drive gear damaged.	b1. *Remove starter and inspect engine starter driven gear (para 2-18).
		b2. *Replace starter driven gear (para 2-18).
	c. Starter failure.	c. *Replace starter assembly (para 2-18).
	d. Engine "hydrostatic lock".	d1. Investigate. Refer to DT 12.
		d2. *Replace engine. Refer to pertinent vehicle technical manual.
	e. Engine seized internally.	e. *Repair and replace as required. (Item 20).
	f. Transmission "locked-up".	f1. Check transmission. Refer to pertinent vehicle technical manual.
		f2. *Replace transmission. Refer to pertinent vehicle technical manual.
1.3 Starter drive spins, but engine does not crank:	a. Starter clutch slipping or engagement assembly damaged.	a. *Replace starter assembly (para 2-18).
	b. Engine starter drive gear damaged (teeth milled).	b1. *Remove starter and inspect engine drive gear (para 2-18).
		b2. *Replace engine drive gear (para 3-31), and install starter (para 2-18).
2. Engine Cranks Too Slow		
2.1 Cranking speed too slow for starting: (below 90 rpm)	a. Batteries partially discharged.	a. Check battery condition. Refer to DT 13.1 and 13.2.
	b. Incorrect seasonal grade of oil. Applies in cold weather.	b. Drain and refill with proper oil. Refer to pertinent vehicle lubrication order.
3. Engine Fails To Start At Normal Cranking Speed		
3.1 Cylinders not firing: (Insufficient fuel or incomplete combustion.)	a. Out of fuel.	a. Refuel.
	b. Air in fuel system.	b. Bleed and purge system. (item 14.1.)
	c. Cylinders too cold. Applies in cold weather.	c1. Operate engine intake manifold heater to assist in starting.
		c2. If engine does not start, check heater operation. Refer to DT 14.

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
Engine Fails To Start At Normal Cranking Speed — Continued		
	d. Low cylinder compression.	d1. Check cylinder compression. Refer to DT 9.
		d2. *Repair or replace cylinder, piston, rings, and/or valves chapter 3.
	e. Throttle linkage disconnected.	e. Check linkage (item 14.3, c.).
	f. Injection Pump or drive deficiency.	f. Check for deficiencies (item 14.6.).
3.2 Cylinders partially firing: (insufficient fuel)	a. Air in fuel system.	a. Bleed and purge system. (item 14.1.)
	b. Water contaminated fuel.	b. Check automatic drain system (Item 14.13.)
	c. Cylinder too cold. Applies in cold weather.	c. Operate engine intake manifold heater to assist starting. Refer to pertinent vehicle technical manual.
	c. Induction air restricted or blocked.	d. Inspect, repair and replace as required. (item 11.1, a, b, c and d.)
	e. Low cylinder compression.	e1. Check cylinder compression. Refer to DT 9.
		e2. *Repair or replace cylinder piston, rings, and/or valves chapter 3.
	f. Injection Pump timing improper.	f. Check timing (refer to para 2-21).
4. Engine Low Idle Abnormal Operation		
4.1 Low-idle speed too low: (below 650 rpm)	a. Insufficient warm-up. Applies in cold weather.	a. Extend warm-up period. Increase warm-up speed to 1000 - 1200 rpm.
	b. Improper idle adjustment.	b. Adjust idle speed (item 14.3a)
	c. One bank not firing.	c1. Increase warm-up speed to 1000 - 1200 rpm. If it does not fire, check injection pump operation. Refer to DT 1.8.
		c2. *Replace injection pump if indicated by DT 1.8. (para 2-21)
4.2 Low-idle speed erratic: (unsteady or surge)	a. Idle speed too low	a. Adjust idle speed. Refer to Item 14.3f.
	b. Accelerator or throttle linkage loose, worn, or cross-shaft shock spring defective.	b. Inspect linkage. Refer to 14.3, a.
	c. One or more cylinders partially firing. (Water or air in fuel system).	c. Refer to Items 14.1, and 14.2.
	d. Injector nozzles defective.	d. Remove and check nozzles. Refer to Item 14.8.
	e. Fuel injection pump governor defective.	e. *Replace defective fuel injection pump (para 2-21).
	f. Injection pump improperly timed.	f. Check timing and inspect pump (para 2-21).
4.3 Misfires at idle: (Usually accompanied by white exhaust smoke, oily, or heavy carbon deposits on exhaust grilles.)	a. Engine operating at idle for extended period during cold weather.	a. Increase engine idle speed to 1000 - 1200 rpm.
5. Engine High-Idle (No-Load) Abnormal Operation		
5.1 High-idle speed too low: (below 2500 rpm)	a. Accelerator or throttle linkage deficiency.	a. Inspect linkage. Refer to item 14.3.
	b. Low fuel pressure. (fuel filter restriction)	b. Check filters. Item 14.5
	c. Fuel injection pump governor defective.	c. *Replace fuel injection pump (para 2-21).
5.2 High idle speed too high: (above 2640 rpm)	a. Cooling fan malfunction.	a. Check fans. Refer to (item 12.1, e.)
	b. Fuel injection pump governor defective.	b. *Replace fuel injection pump (para 2-21).
6. Engine Overspeeds		
6.1 Overspeeds during vehicle operation.	a. Vehicle operating on steep down-grade.	a. Apply vehicle brakes to avoid overspeed.

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
Engine Overspeeds — Continued		
	b. Cooling fans malfunction.	b. Inspect cooling fans and drives. Refer to item 12.1, e. Replace defective parts (para 2-21).
	c. Governor improperly adjusted.	c. Check adjustment (14.6, b). Replace fuel injection pump, governor.
6.2 Engine speed excessive with accelerator pedal released:	a. Accelerator or throttle stuck or disconnected.	a. Inspect throttle linkage. Refer item 14.3, a.
	b. Fuel control stuck.	b. Refer to item 14.6, g.
	c. Fuel injection pump governor defective.	c. *Replace fuel injection pump (para 2-21).
7. Engine Stops During Operation		
7.1 Stops gradually with loss of power and speed: (with accelerator pedal depressed)	a. Out of fuel.	a. Refuel.
	b. Fuel system deficiency.	b. Refer to item 14.
7.2 Stops suddenly:	a. Fuel system deficiency.	a. Refer to item 14.
	b. Engine internal failure.	b. Check for engine damage. Refer to item 20.
8. Engine Fails to Shut Down		
8.1 Fails to stop with electric fuel shut-off:	a. Electric fuel shut-off malfunction.	a. Refer to item 14.6, e.
	b. Defective fuel injection pump governor.	b. *Replace fuel injection pump (para 2-21).
8.2 Fails to stop with manual fuel shut-off:	a. Manual fuel shut-off malfunction.	a. Check throttle linkage. Refer to item 14.6, f.
	b. Defective injection pump.	b. *Replace fuel injection pump (para 2-21).
8.3 Fails to stop when vehicle fuel supply is shut off: (engine will continue to run for 12 to 14 minutes at idle speed after the fuel is shut off)	a. Vehicle fuel shut-off valve malfunction.	a. Inspect fuel shut-off valve. Replace as required.
9. Engine Rough Operation		
9.1 Misfires: (more noticeable at idle operation)	a. Water contaminated fuel.	a. Check fuel for water. Refer to item 14.2.
	b. Engine operating at idle for extended period during cold weather.	b. Increase engine idle speed to 1000-1200 rpm.
	c. Fuel leak, nozzle high pressure tube.	c. Inspect for leak. Refer to item 14.9.
	d. Fuel injector nozzle defective.	d. Refer to item 14.8.
	e. No valve rocker clearance.	e1. Locate faulty cylinder. Refer to DT 8.
		e2. Adjust rockers to proper clearance (para 2-51).
	f. Intake or exhaust valve failure (burned, worn or damaged).	f1. Locate faulty cylinder. Refer to DT-8.
		f2. *Inspect, repair or replace valve and/or cylinder (para 3-68).
	g. Return fuel line disconnected or restricted.	g. Inspect fuel line. Refer to item 14.11.
	h. Flame heater solenoid defective.	h1. Check solenoid operation. Refer to DT-14.5 and DT-14.6, *3* and *5*.
		h2. Replace solenoid. (para 2-43).
9.2 Vibration or roughness:	a. Engine misfire.	a. Refer to item 9.1.
	b. Fuel injection pump defective.	b. Refer to item 14.6.
10. Noisy Operation		
10.1 Knock or tapping sound:	a. Rocker arm assembly defective.	a1. Locate faulty cylinder. Refer to DT-8.
		a2. *Adjust or replace rocker arm (para 2-30).
	b. Excessive intake or exhaust valve clearance or damage.	b1. Locate faulty cylinder. Refer to DT-8.
		b2. Adjust valve clearance (para 2-51).
		b3. *Inspect, repair, or replace valve and/or cylinder (para 3-68).
	c. Connecting rod, piston, or ring damage, or loose piston pin.	c1. Locate faulty cylinder. Refer to DT-8.
		c2. Check for damage. Refer to item 20.
	d. Crankshaft bearing damage.	d. Check for damage. Refer to item 20.
	e. Worn or damaged gears or bearings.	e. Check for damage. Refer to item 20.

Table 2-2. Troubleshooting Procedures – Continued

Malfunction	Probable cause	Corrective action
Noisy Operation — Continued		
10.2 Diesel Knock: ("ping", usually at low-idle speed)	a. Manifold heater solenoid valves defective.	a1. Check solenoid operation. Refer to DT-14.5 and DT-14.6, 3 and 5. a2. Replace solenoid valve (para 2-43).
	b. Return fuel line disconnected or restricted.	b. Inspect fuel line. Refer to item 14.11.
	c. Engine fuel injection timing	c. Check timing (para 2-21).
10.3 Grinding or squeaking sound	a. Cooling fan interference. (Fan housing vane or foreign material).	a. Inspect fan for proper clearance. Repair or replace damaged parts (para 2-21 b (25)).
	b. Engine accessories.	b. Replace damaged accessory (section IV).
	c. Worn or damaged gears, camshaft, rocker arm bearing or bushings.	c. Check for damage. Refer to item 20.
11. Abnormal Exhaust Conditions		
11.1. Excessive black smoke. (one or both banks):	a. Induction air inlets blocked with debris.	a. Inspect and clean air inlet grilles and air cleaner inlets.
	b. Air cleaner restriction (element dirty, wet or blower motor inoperative).	b1. Check restriction. Refer to DT-7. b2. Service filter (clean, dry or replace). Refer to pertinent vehicle technical manual.
	c. Air Cleaner hose collapsed.	c. Inspect, repair or replace. Refer to pertinent vehicle technical manual.
	d. Turbocharger air inlet blocked with plastic plug, tape, rag, etc. (usually one bank only.)	d. Inspect and clean. Refer to pertinent vehicle technical manual.
	e. Turbocharger compressor housing clamp	e. Tighten or replace clamp (para 2-20b).
	f. Turbocharger defective. (Sticky, worn or failed bearings, seals and damaged impeller.)	f. Remove inlet elbows (refer to pertinent vehicle technical manual) and check for bearing play or looseness, impeller damage, or excessive carbon deposits on turbine wheel. Replace defective turbosupercharger (para 2-20 or 2-20.1).
	g. Intake manifold system air leak (Loose, broken, misalined or failed clamp, hose, tube flange, or gasekt.)	g. *Inspect system for leaks and repair as necessary (para 2-28 and 2-20 or 2-20.1).
	h. Exhaust manifold leak. (Loose flange, failed gasket; cracked or damaged manifold or elbow.)	h. Inspect exhaust manifold for leaks and repair as required (para 2-46).
	i. Fuel injection pump timing incorrect.	i. Check timing of fuel injection pump (para 2-21).
	j. Fuel injection pump fuel adjustment improper (overfueled).	j. *Replace fuel injection pump (para 2-21).
	k. Fuel injection pump advance unit defective.	k. *Replace advance unit (para 3-95).
11.2 Excessive bluish smoke during vehicle operation: (one or both banks)	a. High oil consumption.	a. Refer to item 13.7, b and f.
11.3 White (greyish) smoke during low-idle operation: (one or both banks)	a. Engine operating at idle for extended period during cold weather.	a. Increase engine idle speed to 1000-1200 rpm.
11.4 Oily and/or heavy carbon deposits on vehicle rear grill:	a. External oil leaks.	a. Refer to item 13.7, a.
	b. Excessive oil consumption.	b. Refer to item 13.7
	c. Engine operating at idle for extended period during cold weather.	c. Increase engine idle speed to 1000-1200 rpm.
12. Cooling System Deficiencies		
12.1 Engine overheating: (evidenced by high oil temperature, low oil pressure and warning lights "ON").	a. Oil cooler screens and fins blocked with debris.	a. Clean screens and oil cooler finned air passages. **NOTE** Inspect for oil leaks and avoid oil spillage.

Table 2-2. Troubleshooting Procedures – Continued

Malfunction	Probable cause	Corrective action
Cooling System Deficiencies — Continued	b. Restricted cooling air inlets (blocked with debris).	b. Clean air inlets and grilles.
	c. Oil level overfull.	c. Refer to item 13.5.
	d. Seasonal grade of oil improper (too heavy) for ambient temperature.	d. Check oil in engine. Drain and refill with proper grade of oil. Refer to pertinent Vehicle Lubrication Order.
	e. Cooling fan clutch slipping, fan drive failed or blades eroded.	e. Check fan rotation and clutch torque, and inspect fan blades. Repair as required (para 3-90 and 3-95).
	f. Cooling shroud, baffle, deflector or plates loose, cracked or broken.	f. Inspect and repair as required.
	g. Oil cooler thermostatic valve and/or bypass valve defective.	g. *Remove valves and replace (para 2-37 and 2-35).
	h. Engine over-powered due to improper fuel adjustment.	h1. Check engine power. Refer to items 19.1 and 19.2 h2. *Replace fuel injection pump (para 2-21).
	i. Engine operation under full load for extended periods at high ambient temperatures (desert) under heavy load conditions (sand, mud, hills).	i. Limit operation to short periods when operating under such conditions.
13. Abnormal Oil Conditions		
13.1 Low oil pressure — temperature normal:	a. Low oil level.	a. Refer to item 13.4
	b. Seasonal grade of oil improper (oil too light) for ambient temperature.	b. Check oil in engine. Drain and refill with proper grade of oil. Refer to pertinent lubrication order.
	c. Oil diluted with fuel.	c. Refer to item 13.6
	d. Pressure sending unit or gage defective.	d1. Check electrically. Refer to pertinent vehicle technical manual. d2. Repair or replace as required.
	e. Oil pressure regulator valve malfunction.	e. *Inspect for sticky or defective valve. Repair or replace as required (para 2-33).
	f. Defective oil pump or obstructed oil pickup screen.	f. *Remove oil pump and inspect pump and screen. Repair or replace as required (para 3-74).
	g. Crankshaft bearing worn or damaged.	g1. Check for damage. Refer to item 20. g2. *If deposits are found in filter, disassemble engine, clean and repair as required.
13.2 Low oil pressure with:		
a. Normal oil temperature and light "OFF".	a. Oil pressure gage or transmitter defective.	a. Check electrically. Refer to pertinent vehicle technical manual. Replace as required.
b. High oil temperature and warning light "ON".	b. Engine overheating.	b. Refer to item 12.1
c. High oil temperature and warning light "OFF".	c. Warning light burned out.	c. Replace bulb. Refer to pertinent vehicle technical manual.
13.3 High oil temperature with:		
a. Normal oil pressure and warning light "OFF".	a. Oil temperature gage or transmitter defective.	a. Check electrically. Refer to pertinent vehicle technical manual. Replace as required.
b. Normal oil pressure and normal oil temperature.	a. Warning light switch defective.	a1. Check electrically. Refer to pertinent vehicle technical manual. Replace as required.
13.4 Low oil level: (below "add" mark)	a. Vehicle not on level ground during oil level check.	a. Position vehicle on level ground and recheck oil level.
	b. "Oil check" service neglected.	b. Add oil to proper level.
	c. Loss of oil due to oil leak.	c. Inspect for leaks. Repair as required.
	d. High oil consumption.	d. Refer to item 13.7.
13.5 High oil level: (overfull)	a. Overfilled by error.	a. Drain to proper level.
	b. Oil diluted with fuel.	b. Refer to item 13.6.

Table 2-2. Troubleshooting Procedures – Continued

Malfunction	Probable cause	Corrective action
Abnormal Oil Conditions – Continued		
13.6 Oil diluted with fuel: (Evidenced by rising oil level, thin oil consistency)	a. Engine operating at idle for extended periods during cold weather.	a1. Drain oil and refill with proper oil. Refer to lubrication order. a2. Avoid operating at idle for extended periods during cold weather.
	b. Fuel leakage at fuel injector nozzle body.	b1. Locate faulty nozzle. Refer to DT 2.3. b2. Repair or replace nozzle and holder assembly (para 2-48).
	c. Engine fuel supply pump shaft seal leak.	c. Repair or replace pump assembly (para 2-17 or 2-17.1).
	d. Injection pump internal fuel leak into oil.	d. *Replace injection pump (para 2-21).
13.7 Excessive oil consumption: (150:1 (max.) fuel/oil ratio (in gallons))	a. Loss of oil due to leaks.	a. Inspect engine for oil leaks. Repair as required.
	b. Oil level overfull.	b. Refer to item 13.5.
	c. Seasonal grade of oil improper (oil too light) for ambient temperature.	c. Refer to item 13.1, b.
	d. Piston rings or valve guides worn (result of dust ingestion).	d1. Inspect induction system for dust entry (air cleaner seals, hoses and clamps). Repair or replace. Refer to pertinent vehicle technical manual. d2. Verify cylinder compression. Refer to DT-9. d3. *If compression test indicates engine damage, repair or replace cylinder and rings as required.
	e. Piston rings damaged: (scuffed due to engine overheating).	e1. Refer to item 12. e2. Verify cylinder compression. Refer to DT-9. e3. *If compression test indicates engine damage, repair or replace defective parts as required.
	f. Turbocharger defective (worn or damaged seals).	f. Remove inlet and exhaust elbows and check for evidence of oil. Replace defective turbocharger (para 2-20 or 2-20.1)
13.8 Excessive crankcase blow-by: (high crankcase pressure)	a. Heavy carbon deposits in breather tube at turbocharger exhaust pipe.	a1. Refer to DT-11. a2. Clean engine crankcase breather tube.
	b. Rings worn or damaged.	b. Refer to item 13.7,d.
13.9 Generator oil pressure abnormal: (AVDS-1790-2C only).	a. Restricted oil lines.	a. *Inspect lines for plugging or damage.
	b. Failed generator drive gear assembly (coupling assembly).	b. Refer to DT-13.5. Replace drive gear assembly (para 3-51).
	c. Generator oil pump failure.	c1. Refer to DT-10.2. c2. *Replace pump or generator.
14. Fuel System Abnormal Conditions		
14.1 Air in system:	a. Occurred during fuel filter replacement, engine or power pack installation or long period shutdown.	a1. "Purge" fuel system. Turn "ON" master, and in-tank fuel pump switches. Operate in-tank fuel pump for 1 or 2 minutes Simultaneously operate purge pump, completing 4 or 5 strokes after firm handle pressure is noted. **CAUTION** Do not depress flame heater button. a2. With in-tank pumps operating, open bleeder valves (on cover of both primary and fuel water separator filters) until all fuel (no air) is noted.
	b. Return fuel restriction	b. Refer to item 14.11.

Table 2-2. Troubleshooting Procedures

Malfunction	Probable cause	Corrective action
Fuel System Abnormal Conditions — Continued		
	c. Damaged fuel hoses (fuel pump to filter, or filter to fuel injection pump).	c. *Remove and install new hoses (para 3-14b).
14.2 Water contaminated fuel:	a. Automatic drain system inoperative.	a. Refer to item 14.13.
14.3 Accelerator and throttle linkage deficiencies.	a. Insufficient throttle travel.	a. Place ¾ inch wide piece of writing paper over end of high idle adjusting screw and depress accelerator pedal fully. If control lever stop contacts adjusting screw and holds paper tightly, full throttle travel exists. (para 2-21b (15)). Repeat above after each of the following steps.
	b. Vehicle accelerator linkage loose, worn, binding, disconnected, improperly adjusted, or pedal return spring malfunction.	b. Inspect, repair, and adjust. Refer to pertinent vehicle technical manual.
	c. Engine throttle linkages loose, worn, binding, improperly adjusted or disconnected.	c. Inspect, repair or replace as necessary (para 2-40 or 2-40.1).
	d. Engine throttle cross shaft idle or full-throttle positions improperly adjusted.	d. Adjust to proper stop clearances (para 2-21b (15)).
	e. Engine throttle cross shaft shock spring defective (broken spring allows free movement between tangs and lever pins).	e1. Inspect for broken spring and replace. e2. Check free movement. Replace spring if clearance is greater than 0.010 inch.
	f. Improper low idle adjustment (engine crosshaft idle screw).	f1. Adjust low idle screw to proper engine speed (675-725 rpm). Turn clockwise to increase and counter clockwise to decrease speed (para 2-21b (15)). f2. If speed below 725 rpm cannot be obtained with adjustment f1, proceed to item 14.6.
	g. Engine will not maintain 1800 rpm speed during winching operations.	g. Adjust solenoid control speed screw or replace throttle control solenoid assembly (para 2-49.2).
14.4 In-Tank fuel pump deficiencies:	a. Electric circuit defective, or electric motor failure.	a1. Check if operative. Refer to DT-6.1. a2. Check electric circuit. Refer to pertinent vehicle technical manual, and repair as required. a3. Replace pump assembly. Refer to pertinent vehicle technical manual.
	b. Pump output insufficient. (Defective pump, or screen clogged.)	b1. Check pressure and output. Refer to DT-6. b2. Repair or replace pump. Refer to pertinent vehicle technical manual.
14.5 Fuel filter restriction:	a. Primary and/or fuel/water separator filter element clogged. (Dirt, water-soaked or waxed.)	a. Check fuel pressure. Refer to DT-1.2. Replace defective filter elements (para 2-24 and 2-25).
14.6 Fuel injection pump deficiencies:	a. Fuel injection pump governor low-idle speed adjustment improper.	a1. Adjust low-idle stop screw on fuel injection pump (para 2-21b (15)). **NOTE** Required only when engine speed cannot be adjusted as described in item 14.3. a2. *If low idle speed cannot be obtained, replace fuel injection pump (para 2-21).
	b. Fuel injection pump governor high-idle speed improper.	b1. Check high idle speed. Refer to DT-15.1.

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
Fuel System Abnormal Conditions — Continued		
	e. Electric fuel shutoff failure. (Electric circuit defective or solenoid failure).	e1. Check solenoid operation. Refer to DT-5.1. e2. Check circuit voltage. Refer to pertinent vehicle technical manual. e3. •Replace fuel injection pump cover and solenoid assembly (refer to pertinent injection pump technical manual or replace fuel injection pump (para 2-21).
	f. Manual fuel shut-off malfunction (improper control linkage adjustment or internal failure).	f1. Check manual operation (refer to DT-5-2). f2. Check control for full travel or disconnected linkage. Adjust or repair as required (para 2-21). f3. •Remove fuel injection pump shut off cover and inspect lever operation. If defective, replace cover assembly (refer to pertinent fuel injection pump technical manual) or replace fuel injection pump (para 2-21).
	g. Fuel control stuck in "no-fuel" position (result of improper preservative oil during long term storage and occurs during initial start when engine is stopped because of resulting overspeed).	g1. Operate engine fuel shut-off (electric and manual separately) six or eight times. This may free fuel control from stuck position. Attempt engine start. g2. Check fuel injection operation. Refer to DT-1.5. g3. Remove fuel shut-off cover and inspect fuel control levers (lever is stuck when in extreme right position). Refer to pertinent fuel injection pump technical manual. g4. Manually move lever to the left, counter clockwise, and alternately rotate (both directions gradually) until full travel and complete freeness of lever is obtained. g5. Reinstall fuel shut-off cover and check engine for normal start. g6. •If engine fails to start, replace fuel injection pump (para 2-21).
	h. Fuel injection pump drive coupling failure (pump not rotating).	h1. Check fuel injection pump rotation. Refer to DT-3.2. h2. •Replace fuel injection pump (para 2-21).
	i. Pressure regulating valve (fuel return) defective.	i1. Check fuel pressure. Refer to DT-1.3. i2. If valve is defective, replace valve. Refer to pertinent fuel injection pump technical manual.
	j. Fuel leakage internally (hydraulic head gasket or housing porosity leaks fuel into engine oil).	j. •Replace fuel injection pump (para 2-21).
	k. Injection pump timing improper.	k. Check timing (para 2-21).
	l. Fuel injection pump internal failure.	l1. Check fuel injection pump operation. Refer to DT-1.5. l2. Replace injection pump (para 2-21). NOTE Remove and bench test all nozzles (DT-2.2) after injection pump internal failure.
14.7 Engine fuel supply pump defective:	a. Fuel pump failure (insufficient fuel output due to defective regulating valve, internal pump wear or shaft seal leak causing fuel leakage into engine oil).	a1. Check fuel pressure and refer to DT-1.4. a2. Repair or replace defective fuel pump assembly (para 2-21).

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
Fuel System Abnormal Conditions — Continued		
14.8 Fuel injector nozzle defective:	a. Abnormal spray pattern (sticky action, stuck partially open, or orifices partially plugged).	a1. Locate faulty cylinder. Refer to DT-2. a2. Repair or replace defective nozzle and holder assembly (para 2-48).
	b. Fuel injector nozzle valve stuck closed or orifice plugged. NOTE Can result in damaged fuel injection pump.	b1. Bench test injector nozzle. Refer to DT-2.2. b2. Repair or replace defective fuel injector nozzle and holder assembly (para 2-48). b3. •If defective fuel injector nozzle is found, the fuel injection pump must be tested for damage. Refer to DT-1.5. Replace defective pump (para 2-28).
	c. Fuel injector nozzle holder spring failed (result of improper installation of nozzle).	c1. Locate faulty nozzle. Refer to DT-2. c2. Repair or replace fuel injector nozzle and holder assembly (para 2-28).
	d. Fuel leakage at fuel injector nozzle body.	d1. Locate faulty fuel injector nozzle. Refer to DT-2.3. d2. Repair or replace fuel injector nozzle and holder assembly (para 2-28).
14.9 Fuel injector tube high pressure fuel leakage:	a. Fitting loose, tubing cracked or broken.	a1. Tighten fitting nut (para 2-21b. (16)). a2. Inspect tubing sleeve (para 3-137). a3. •Replace defective tube (para 3-137).
	b. Fuel injector tube clamps (loose or missing clamps allow tube vibration resulting in fuel leaks).	b. Tighten loose clamps, replace damaged clamps and install missing clamps (para 2-21).
14.10 Fuel injection pump pressure regulating valve fuel return valve defective:	a. Valve sticking or spring tension improper.	a1. Check fuel pressure. Refer to DT-1.3. a2. Inspect and/or replace valve. Refer to TM 9-2910-212-34.
14.11 Engine fuel return restriction:	a. Engine fuel return hose quick disconnect coupling not connected.	a. Reconnect coupling. Refer to pertinent vehicle technical manual.
	b. Quick disconnect coupling, tube or hoses defective or damaged (restricting return fuel flow).	b1. Check return fuel flow. Refer to DT-4.1. b2. Replace defective coupling tube or hose. Refer to pertinent vehicle technical manual.
14.12 Fuel return check valve defective	a. Check valve not seating (leaking at seat).	a1. Remove and inspect valve for proper seating (no leakage). a2. Replace valve (para 2-21a (13)).
14.13 Automatic water drain system inoperative:	a. System malfunction (water not draining).	a1. •Open manual drain cock (para 2-24) and drain into container. If more than one quart of water is drained, system is inoperative. a2. If excessive water is found in filter, replace filter elements (para 2-24).
	b. Electrical wiring defect.	b. •Check voltage supply to control unit and repair or replace wiring as required (para 2-41), refer to pertinent vehicle technical manual.
	c. Solenoid valve defective.	c. •Apply 24 volts to solenoid and check operation. If defective, replace solenoid valve (para 2-44).
	d. Control unit or sensors defective.	d. •Replace control unit and sensor assembly (para 2-44).
14.14 Deleted		

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
15. **Generator Abnormal Operation**		
15.1 Not charging: (Indicator reads in "yellow" same as battery reading with engine stopped and master switch "ON".	a. Battery cables or terminals loose, corroded, broken or disconnected (connector nuts not tightened).	a1. Check battery condition. a2. Inspect and repair cables and terminals. Refer to pertinent vehicle technical manual.
	b. Defective electrical circuits or voltage regulator.	b1. Check circuits and voltage regulator. Refer to pertinent vehicle technical manual. b2. Repair or replace as necessary. Refer to pertinent vehicle or generator technical manual.
	c. Generator failed.	c1. Check circuits and generator. Refer to pertinent vehicle or generator technical manual. c2. Repair and replace as necessary. Refer to pertinent vehicle technical manual. c3. Refer to DT-13.6. c4. *Replace generator (para 2-19). Clean generator oil drain tubes of obstructions (model AVDS-1790-2C only).
	d. Failed generator drive gear assembly.	d1. *Refer to DT-13.7. d2. *Replace drive gear assembly (para 3-31).
15.2 Undercharging: (Maximum indicator reading in "yellow" during vehicle operation).	a. Loose, corroded or grounded battery terminals or cables.	a. Inspect, clean, tighten, repair or replace as necessary. Refer to pertinent vehicle technical manual.
	b. Defective batteries.	b1. Check individual battery cells. Refer to pertinent vehicle technical manual. b2. Replace batteries. Refer to pertinent vehicle technical manual.
	c. Voltage regulator defective.	c. Inspect voltage regulator and replace if necessary. Refer to pertinent vehicle technical manual.
	d. Failed generator drive gear assembly.	d1. *Refer to DT-13.7. d2. *Replace drive gear assembly (para 3-31).
15.2 Overcharging: (Indicator reads right "red").	a. Loose or corroded battery terminals, or grounded cables.	a. Inspect, clean, tighten, or repair as necessary. Refer to pertinent vehicle technical manual.
	b. Defective batteries.	b. Check individual battery cells. Replace defective batteries. Refer to pertinent vehicle technical manual.
	c. Voltage regulator defective.	c. Inspect voltage regulator and replace if necessary. Refer to pertinent vehicle technical manual.
15.3 Discharging: (Indicator reads in left "red")	a. Heavy load or "short" in vehicle system.	a. Check electrical system circuits. Refer to pertinent vehicle technical manual.
15.4 Erratic charging: (Indicator fluctuates)	a. Loose or corroded battery terminals, grounded cables, or defective battery.	a. Inspect, clean, tighten, or repair as necessary and check batteries. Refer to pertinent vehicle technical manual.
16. **Intake Manifold Heater Abnormal Operation**		
16.1 Heater inoperative:	a. Electrical or fuel system malfunction.	a. Check heater operation. Refer to DT-14. Repair or replace defective parts as indicated by tests.

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
17. Vehicle Air Cleaner Blower Inoperative		
17.1 Motor inoperative:	a. Generator not charging.	a. Check operation of generator, regulator, and related circuits. Refer to item 15.1.
	b. Blower motor electric circuit defective.	b. Check circuits. Refer to pertinent vehicle technical manual. Repair or replace as required.
	c. Blower motor failure.	c1. Refer to DT-7.1
		c2. Replace motor. Refer to pertinent vehicle technical manual.
18. Engine Time Totalizing Meter Inoperative		
18.1 Totalizing meter inoperative.	a. Generator inoperative.	a. Check generator. Refer to item 15.1.
	b. Wiring defective.	b. Check circuit voltage to totalizing meter lead. Refer to pertinent vehicle technical manual.
	c. Totalizing meter defective.	c. Replace totalizing meter (para 3-8).
19. Low Power Investigation		

NOTE

When low power or poor vehicle performance is reported, an engine "stall" speed test will indicate whether the malfunction is engine or vehicle related. If a rough, noisy, or overheated engine is associated with the reported low power, prior correction of these malfunctions often will eliminate the poor performance and, in addition, may prevent further damage to the engine.

Malfunction	Probable cause	Corrective action
19.1 Preliminary investigation:	a. Engine rough operation.	a. Refer to item 9.
	b. Engine noisy.	b. Refer to item 10.
	c. Engine overheating.	c. Refer to item 12.
19.2 Power verification: (Perform engine "stall" test in accordance with DT-15.2)	a. If stall speed is normal (1800-1950 rpm), low performance is vehicle related or vehicle may be operating under severe conditions.	a1. Investigate transmission clutches, brakes, and vehicle suspension for being too tight. Repair as required. Refer to pertinent vehicle technical manual.
		a2. Check vehicle performance on hard road, and if performance is satisfactory, limit vehicle operation under severe condition to short periods of operation. Possible engine damage may be prevented.
	b. If stall speed is above normal (more than 1950 rpm) low performance is transmission related, or engine is overpowered.	b1. Investigate for transmission slippage. Refer to vehicle technical manual.
		b2. Refer to item 14.6, d.
	c. If stall speed is below normal (less then 1800 rpm) low performance is engine related.	c. Proceed with engine low power investigation. Refer to item 19.3.
19.3 Low stall with both banks firing and normal smoke:	a. In-tank fuel pump inoperative.	a. Check in-tank fuel pump operation. Refer to item 14.4. Repair as required.
	b. Throttle travel limited.	b. Inspect accelerator and throttle linkages. Refer to item 14.3, b. Repair as required.
	c. Water contaminated fuel or improper fuel.	c. Check fuel system for water content. Refer to item 14.2. Service as required. Refer to pertinent vehicle technical manual for proper fuel specification.
	d. Fuel filter restriction. (dirty)	d. Inspect fuel filters. (Refer to item 14.5). Service filters as required.
	e. Fuel return restriction.	e. Inspect fuel return. Refer to item 14.11. Repair as required.
	f. Fuel supply leaks.	f. Inspect for leaks and repair.
	g. Governor high-idle adjustment improper.	g. Check high-idle operation. Refer to item 14.6, b. Replace fuel injection pump (para 2-21).

Table 2-2. Troubleshooting Procedures — Continued

Malfunction	Probable cause	Corrective action
Low Power Investigation — Continued		
	h. Fuel injection pump fuel adjustment improper.	h. Check adjustment. Refer to item 14.6, d. Replace injection pump (para 2-21).
	i. Engine fuel supply pump defective.	i. Check pump operation. Refer to item 14.7. Repair or replace as required.
	j. Fuel injection pump fuel pressure regulating valve defective.	j. Inspect valve. Refer to item 14.10. Replace as required.
	k. Fuel injection pump timing improper.	k. Check timing (para 2-21). Retime as required.
19.4 Low stall speed with black exhaust smoke: (one or both banks).	a. Vehicle air cleaner inlets blocked with debris.	a. Inspect and clean.
	b. Air cleaner restriction.	b. Check air cleaner. (Refer to DT-7) Service as required.
	c. Air cleaner hose collapsed.	c. Inspect hose. Replace as required.
	d. Turbosupercharger air inlet blocked.	d. Inspect turbosupercharger inlet. Refer to item 11.1, d.
	e. Turbosupercharger deficiency.	e. Inspect turbosupercharger. Refer to item 11.1, e & f.
19.5 Low stall with excess bluish exhaust smoke: (one or both banks)	a. Worn or damaged rings with excessive oil consumption.	a. Refer to item 13.7, d.
19.6 Low stall with one bank not firing:	a. Fuel injection pump malfunction.	a1. Refer to DT 1.8. a2. *Replace fuel injection pump (para 2-21).
20. Engine Internal Damage		
20.1 Engine will not rotate, or rotates with binding, grinding or squealing noise:	a. Engine seized; failed or damaged connecting rod, bearing, piston, gears, etc.	a1. Drain oil; inspect oil and filters for metal materials. a2. *Repair or replace engine as necessary.
	b. Engine hydrostatic lock damage.	b. *Investigate. Refer to DT-12.
21 Smoke Generating System Abnormal Operation		
21.1 Engine fails to produce smoke when engine is operating and smoke generating system is activated:	a. Fuel shut-off valve closed.	a. Open fuel shut-off valve.
	b. No generator output.	b1. Bring engine speed to 1000 rpm momentarily to insure generator output. b2. Troubleshoot generator malfunction 15.
	c. Restricted fuel tube adapters in exhaust pipes.	c. Replace fuel tube assemblies.
	d. Air cleaner blower motors not operating.	d. Refer to pertinent vehicle technical manual.
	e. Ruptured fuel hose or tube.	e. Replace fuel hose or tube.
	f. Fuel solenoid valve(s) not operating.	f. Replace solenoid valve(s).
	g. Restricted fuel hose or tube.	g. Replace fuel hose or tube.

Table 2-2. Troubleshooting Procedures – Continued

Malfunction	Probable cause	Corrective action
Smoke Generating System Abnormal Operation – Continued		
21.2 Smoke produced is of poor quality.	a. Loss of fuel from loose connection or ruptured hose or tube.	a. Tighten connection or replace hose or tube.
	b. Restricted fuel hose or tube.	b. Replace hose or tube.
	c. Restricted fuel filters.	c. Service fuel filters.
	d. Restricted fuel tube adapters in exhaust pipes.	d. Replace fuel tube assemblies.
21.3 Smoke produced when smoke generating system is not activated.	a. No current to solenoid valves.	a. Repair wiring harness.
	b. Solenoid valve(s) defective.	b. Replace solenoid valve(s).

NOTE

Refer to Chapter 4 for AVDS-1790-2CA and AVDS-1790-2DA troubleshooting.

Diagnostics Tests
(Contents)

DT No. *Test Description*

1 Fuel Pressure Tests
  1.1 Normal Fuel Pressure
  1.2 In-tank Fuel Pump
  1.3 Primary Fuel Filter
  1.4 Fuel/Water Separator
  1.5 In-tank Fuel Pumps
  1.6 Fuel Pressure Regulating (Fuel Return) Valve Test
  1.7 Engine Fuel Supply Pump
  1.8 High Pressure Fuel Check
2 Fuel Injector Nozzle Tests
  2.1 Nozzle Malfunction
  2.2 Bench Test
  2.3 Nozzle Loose in Cylinder
3 Fuel Injection Pump Tests
  3.1 Pumping Action
  3.2 Pump Rotation
4 Engine Fuel Return Test
  4.1 Return Fuel Flow
5 Engine Fuel Shut-off Operational Check
  5.1 Electric Control
  5.2 Manual Control
6 Vehicle In-Tank Fuel Pump Operation
  6.1 Pump Operational Check
  6.2 Pump Fuel Pressure
  6.3 Pump Output (Fuel Flow Capacity)

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
Fuel Pressure Tests — Continued		
DT 1.3 Primary Fuel Filter Test:		
1. Repeat DT 1.1, 1 through 3.	a. 40 psi at fuel/water separator filter, and below 1 psi at primary fuel filter.	a. Primary filter restriction. Element dirty or clogged.
DT 1.4 Secondary Fuel/Water Separator Filter Test:		
1. Repeat DT 1.1, 1 through 3.	a. 40 psi at fuel/water separator filter, and below 1 psi at primary fuel filter.	a. Primary filter restriction. Element dirty or clogged.
DT 1.4 Secondary Fuel/Water Separator Filter Test:		
1. Repeat DT 1.1, 1 through 3.	a. Below 40 psi at fuel/water separator filter and 1-3 psi at primary fuel filter.	a. Fuel/water separator filter restriction. Coalescer elements dirty or clogged.
DT 1.5 In-tank Fuel Pump (s) Malfunction Test:		
1. Repeat DT 1.1, 1 and 2.	a. 5-7 psi at fuel/water separator filter, and 5-7 psi at primary fuel filter. b. Below 5 psi at fuel/water separator filter, and below 5 psi at primary fuel filter.	a. In-tank pump (s) operation normal. b. In-tank pump (s) malfunction. Screens clogged or pump (s) defective.
DT 1.6 Fuel Pressure Regulating (Fuel Return) Valve Test:		
1. Repeat DT 1.1, 1 through 3.	a. 40 psi at fuel/water separator filter, and 1-3 psi at primary fuel filter. b. Below 40 psi at fuel/water separator filter, and 1-3 psi at primary fuel filter.	a. Valve functioning properly. b. Valve malfunction. Valve stuck or spring defective.
DT 1.7 Engine Fuel Supply Pump:		
1. Repeat DT 1.1, 1 through 3.	a. 40 psi at fuel/water separator filter, and 1-3 psi at primary filter. b. Below 40 psi at fuel/water separator filter, and 1-3 psi at primary fuel filter.	a. Pump operation normal. b. Pump malfunction. Regulator Valve or pump defective.
DT 1.8 High Pressure Fuel Check:		
1. Remove one engine cover on each side of engine for access to fuel injector nozzle tube fittings.		
2. Crank engine with fuel switch "ON", or start engine and operate at idle speed.		
3. Loosen fuel injector tube fitting at nozzle end sufficiently to allow fuel leakage (one nozzle on each side of the engine).	a. High pressure fuel spray pulsations at nozzle fitting. b. No fuel spray pulsations noted at nozzle fitting.	a. Fuel injection pump action is normal. b. Fuel injection pump deficiency. NOTE Test all fuel injector nozzles for proper operation after a fuel injection pump failure (refer to DT 2.2.)
DT 2. Fuel Injector Nozzle Tests		
DT 2.1 Nozzle Malfunction:		
1. Perform test DT 1.8, one cylinder at a time with engine idling (all engine covers removed).	a. Note cylinder on which no change in engine operation occurs, or if cylinder misfire still exists.	a. Cylinder is not firing due to defective nozzle.
2. •Alternate check with power pack removed. Operate engine at idle speed.	a. Note if cylinder temperature is cold (by touch) at intake port area of cylinder head.	a. A cold cylinder indicates the cylinder is not firing due to defective nozzle.
DT 2.2 Bench test		
1. Install nozzle and holder assembly on tester.		
2. Perform nozzle test (refer to para 2-48).	a. Spray pattern and nozzle leakage test requirements.	a. If spray pattern is not acceptable and leakage is noted, nozzle is defective.
DT 2.3 Nozzle Loose in Cylinder		
1. Operate engine at idle speed.	a. Note any movement (jumping) of nozzle in cylinder head (visually or by touch).	a. Movement indicates loose nozzle cap nut in body, or collapsed nozzle holder spring. Nozzle is defective.

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
DT 3. Fuel Injection Pump Tests		
DT 3.1 Pumping Action		
1. Perform Test DT 1.8	a. High pressure fuel spray pulsations.	a. Spray pulsations indicate fuel injection pumping action is satisfactory. No spray pulsations indicates a defective pump.
DT 3.2 Pump Rotation		
1. Remove top deck, engine rear cooling fan vane and rear fan.		
2. Crank engine.	a. Fuel injection pump shaft.	a. Drive coupling is satisfactory if coupling and pump rotate.
	b. Fuel injection pump shaft and/or coupling do not rotate.	b. Fuel injection pump coupling failed or loose on pump shaft.
DT 4. Engine Fuel Return Test		
DT 4.1 Return Fuel Flow		
1. Open rear grille doors and remove transmission cover. Disconnect tank fuel return hose quick disconnect coupling at rear of transmission.		
2. Hold quick disconnect coupling valve open to collect fuel in suitable container. CAUTION Do not operate engine unless coupling valve is held open.		
3. Start and operate engine at idle speed and collect fuel in container.	a. Moderate fuel flow from coupling valve (approx. 1/2 gpm).	a. No restriction. Return fuel flow rate is satisfactory.
	b. Trickle or no flow from hose	b. Fuel flow is insufficient. Pinched or kinked line or quick disconnect coupling valve defective.
4. Remove coupling half from fuel tank tube and connect coupling halves on hose; operate engine (3. above):	a. Moderate flow.	a. Quick disconnect coupling valve satisfactory.
	b. Trickle or no flow.	b. Fuel tank return tube or hose pinched or kinked, or quick disconnect coupling defective.
DT 5. Engine Fuel Shut-Off Operational Check		
DT 5.1 Electric Control:		
1. Open top grille door,with Master Switch "ON", intermittently operate fuel shut-off switch "ON" and "OFF" (with manual control in normal engine "ON" position).	a. Note for audible solenoid "clicking" indicating opening and closing action.	a1. Audible "clicking" indicates normal fuel shut-off operation. a2. No audible "clicking" indicates solenoid or circuit defective.
DT 5.2 Manual Control:		
1. With Master Switch "ON" hold manual control handle in engine "OFF" position and intermittently operate electric fuel shut-off switch "ON" and "OFF".	a. If no audible "clicking" is noted.	a. Manual control is holding fuel shut-off in "OFF" position and manual operation is satisfactory.
	b. Audible "clicking" is noted.	b. Manual control out of adjustment, or defective.
DT 6. Vehicle In-Tank Fuel Pump Operation		
DT 6.1 Pump Operational check		
1. Open top grilles, Turn master switch "ON". Turn in-tank pump fuel switch "ON".	a. Electric pump operation audible (left and right fuel tanks).	a. Pump(s) is operative.
	b. Pump (s) operation not audible.	b. Pump(s) is inoperative.
DT 6.2 Pump Fuel Pressure.		
1. Perform Test DT 1.2.		

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
Vehicle In-Tank Fuel Pump Operation — Continued		
DT 6.3 Pump Output: (Fuel Flow Capacity)		
1. Open left grille doors. Disconnect fuel tank supply hose quick disconnect coupling valve at engine.		
2. Open coupling valve (hold open) to collect fuel in suitable container (5 gallon).		
3. Turn master and in-tank fuel pump switches "ON".		
4. Time fuel flow into measured container.	a. 3 gpm fuel flow.	a. Pump output is satisfactory.
	b. Fuel flow below 3 gpm.	b. Pump output below normal.
DT 7 Vehicle Air Cleaner Tests		
DT 7.1 Pre-cleaner Blower:		
1. Start engine and operate at idle.	a. Note blast of air (on hand) from pre-cleaner air exhaust outlets, two on each air cleaner.	a. Blast of air indicates blower(s) is operating.
	b. No air blast.	b. Blower(s) is inoperative.
DT 7.2 Air Cleaners:		
1. Perform "stall" test (Refer to DT 15.2)	a. Normal speed (1800 - 1950 rpm)	a. Air cleaner elements satisfactory.
	b. Speed below normal.	b. Proceed to 2 below.
CAUTION Do not perform under dusty conditions.		
2. Open doors, remove elements, clean element chamber and close doors. Repeat stall test.	a. If engine speed increases from speed obtained in 1, b to normal speed (1800-1950 rpm).	a. The elements are dirty.
DT 8. Cylinder Fault Isolation Test		
DT 8.1 Audible Check:		
1. Open grilles, remove top deck, engine shroud and covers for access to cylinders.		
2. Operate engine at idle.	a. Listen or use sounding rod to determine noisy cylinder.	a. Location of noise isolates faulty cylinder.
DT 8.2 Fuel "Shorting" Method:		
1. Perform Test DT 1.8		
2. Check all cylinders, one at a time.	a. Note cylinder on which no change in engine operation occurs, knock disappears or decreases, and/or engine roughness or misfire still exists.	a. Indicates faulty cylinder. Defective nozzle, tight rocker arm, worn valve or hydrostatically damaged connecting rod.
DT 8.3 Cylinder Compression Method:		
1. Perform Test DT 9	a. Note cylinder with low pressure. (Below 330 psi at 140-180 cranking rpm).	a. Indicates faulty cylinder. Damaged rings, piston, valve, connecting rod or tight rocker arm. No valve clearance.
DT 9. Cylinder Compression Test		
DT 9.1 Compression Test:		
1. Remove top deck, engine shroud and covers for access to fuel injector nozzles		
2. Start and warm up engine to operating temperature (140°F.)		
3. Stop engine and remove injector nozzles from all cylinders.		
4. Hold fuel shut-off (engine "stop") switch and crank engine several revolutions to expel fluids from cylinders		

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
Cylinder Compression Test — Continued		
5. Install compression adapter and gage in cylinder.		
6. Hold fuel shut-off (engine "stop" switch) and crank engine.	a. Record maximum cylinder pressure.	a. Cylinder pressures of 330-480 psi at engine cranking speed of 140-180 rpm are normal.
7. Repeat 5 and 6 above on all cylinders.	a. Compare pressures of all cylinders.	a. A pressure difference of 70 psi (max.) between high and low cylinder(s) (possible zero valve clearance).
DT 10. Oil Pressure Tests		
DT 10.1 Main Gallery:		
1. Remove engine access plate in turret. Remove engine low oil pressure switch (para 3-85). Install 100 psi gage in engine low oil pressure switch opening (para 3-85).		
2. Start and operate engine at idle speed (675-725 rpm) until operating temperature (140° F.) is reached.	a. 15 to 25 psi at 200° and 140° F. respectively.	a. Oil pressure is normal.
3. Operate engine at high idle (2500-2640 rpm)	a. 40 and 70 psi at 220° and 140° F. respectively.	
DT 10.2 Generator Oil Models AVDS-1790-2C and AVDS-1790-2CA) Pump:		
1. *Remove pipe plug and install 200 psi gage in opening in oil pump at end of generator.		
2. Start and warm up engine at idle speed (675-725 rpm) to operating temperature (140° F.)	a. Oil pressure 100 ± 10 psi.	a. Generator oil pump operation is normal, the generator is rotating and the drive coupling is functioning.
	b. Oil pressure same as normal engine gallery pressure (15-25 psi).	b. Generator oil pump failed, and/or generator not rotating, and/or drive coupling failed (Refer to DT 13.7, 2).
DT 11. Crankcase Blow-by Test		
DT 11.1 Crankcase Pressure		
1. Open rear grille doors and remove transmission cover. Install 10 inch H_2O gage in crankcase breather system.		
2. Start engine, warm up to operating temperature and perform "stall" test.	a. 5 inch H_2O (max.) pressure.	a. Crankcase pressure is normal.
	b. Above 5 inch H_2O pressure.	b. Crankcase pressure is high, indicating excessive blow-by or restricted crankcase vent at turbocharger exhaust outlet pipe.
DT 12. Hydrostatic Lock Test		
DT 12.1 Cranking Attempt:		
1. With master switch "ON" hold fuel shut-off (engine "stop") switch.		
2. Press starter switch momentarily (approx. 3 seconds).	a. Audibly note normal starter engagement action.	a. Starter energized and engagement proper.
	b. Engine does not crank.	b. Fluid in cylinder chamber causing hydrostatic lock. Hydrostatic damage to engine may exist.
DT 12.2 Clearing Hydrostatic Lock:		
1. Remove top deck, engine shroud and covers for access to injector nozzles.		
2. Remove all fuel injector nozzles.		
3. *Drain intake manifolds.		

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
Hydrostatic Lock Test — Continued		
3. Hold fuel shut-off (engine "stop") switch and crank engine several revolutions (5-10 seconds).	a. If knock occurs, cease cranking.	a. Connecting rod or piston damage exists.
	b. Note fluid blown from cylinders.	b. Combustion chamber clear.
DT 12.3 Damage Check (In Vehicle):		
1. Perform compression check (Refer to Test DT-9).	a. Cylinder(s) compression below 330 psi or pressure differential exceeds 70 psi between cylinders.	a. Hydrostatic damage may exist (bent connecting rod).
DT 13. Generator Operational Tests		
DT 13.1 Indicator: (Battery/Generator) Preliminary Check.		
1. Master switch "OFF".	a. Indicator needle at extreme left. (No voltage indicated.)	a. Indicator satisfactory.
	b. Indicator needle at any position other than extreme left.	b. Indicator defective.
2. Turn master switch "ON".	a. Indicator needle moves into "yellow" area (indicating battery voltage) with panel lights on.	a. Indicator satisfactory.
	b. Indicator needle does not move from extreme left position with panel lights on.	b. Indicator defective.
DT 13.2 Battery Preliminary Check:		
1. Turn master switch "ON".	a. Indicator needle in "yellow" area.	a. Battery charge satisfactory.
	b. Indicator needle in left "red" area.	b. Batteries discharged.
	c. Indicator needle in "green" area.	c. Batteries overcharged.
	d. Indicator needle at extreme left position.	d. Batteries dead or cables disconnected or corroded.
DT 13.3 Generator Operating Preliminary Check:		
1. Start and operate engine at 1000-1200 rpm.	a. Indicator needle in "green" area.	a. Generator charging normal.
	b. Indicator needle in "yellow" area (same location as battery check DT 13.2).	b. Generator not charging.
	c. Indicator needle in "yellow" area (slightly higher than battery check DT 13.2).	c. Generator charging slowly (below normal).
	d. Indicator needle in left "red" area.	d. Batteries discharging. (Possible reversed cable connections.)
	e. Indicator needle in right "red" area.	e. Generator overcharging and voltage regulator is malfunctioning.

Master Switch "OFF" Position of Pointer on Gage

GENERATOR - BATTERY INDICATOR GAGE

	RED	YELLOW	GREEN	RED

BATTERY CHARGE CONDITION WITH MASTER "ON" AND ENGINE "OFF"

Under	Normal	Over	

GENERATOR CHARGING CONDITION WITH ENGINE RUNNING

Discharge	Under	Normal	Over

Procedure	Observation	Analysis
DT 13.4 Generator Electrical Check:		
1. Check ohm and continuity readings with test meter.	a. Values per pertinent vehicle manual.	a. Per pertinent vehicle manual.
DT 13.5 Generator Rotation Check:		
1. Perform Test DT 10.2.		
DT 13.6 Generator Electrical Failure:		
1. *Remove generator from engine.		

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
Generator Operational Tests — Continued		
2. Inspect generator windings and insulation. (Accessible through drive end plate,) and check for free rotation of drive shaft - turning shaft by hand.	a. Damaged winding - burned insulation debris, and odor - also observe for debris in drain tubes and freeness of rotation, of generator shaft.	a1. Debris and odor indicates generator burned out. Rotational bind indicates failure. a2. If above not evidenced, generator may have electrical failure or drive gear assembly failure. (Refer to DT 13.7)
DT 13.7 Generator Drive Gear Assembly Torque Check: (Model-AVDS-1790-2C only)		
1. *Functional Check. Perform Test DT 10.2.		
2. *Torque check (generator removed). Check slip torque of drive gear assembly with generator coupling tool (8, fig. 2-5) and torque wrench (300 lb. ft. capacity). Block engine to prevent rotation while gradually increasing torque to 167 lb. ft.	a. Note if there is slippage of the drive gear while increasing torque to 167 lb. ft.	a1. If slippage occurs below 167 lb. ft., drive gear assembly is defective. a2. If no slippage occurs below 167 lb. ft., slip torque is acceptable, but gear assembly may have other damage (low torque rate). Proceed to 3 below.
3. Check torque-rotational deflection rate. Using tool and torque wrench as in 2 above, apply 167 lb. ft. torque.	a. Note deflection in degrees from zero torque to 167 lb. ft. torque.	a1. If rotation is more than 8°, but less than 17°, drive gear assembly is satisfactory. a2. If rotation is greater than 17°, or less than 8°, the drive gear assembly is defective.
DT 14. Manifold Heater Tests		
DT 14.1 Heater Operational Check		
1. Hold fuel shut-off (engine "stop") switch and crank engine.		
2. While cranking engine, engage manifold heater switch and hand operate purge pump.		
3. Place hand on intake manifold heater housing. Check both sides of engine.	a. Note housing temperature (warm or hot to touch).	a1. Evidence of heat indicates heater operation is normal. a2. No heat indicates heater is inoperative.
DT 14.2 Voltage Checks: NOTE Disconnect purge pump fuel hose quick-disconnect coupling at engine before performing tests DT 14.2 through DT 14.5.		
1. Check electrical circuit voltages (master switch and heater switch "ON").	a. 24 volts at heater switch, both connectors.	a. Proper voltage supply through heater switch.
	b. No voltage to switch.	b. Defective circuit.
	c. No voltage from switch.	c. Defective switch.
	d. 24 volts at engine bulk-heat connector.	d. Proper voltage supply.
	e. No voltage to bulkhead connector.	e. Defective circuit between switch and connector.
	f. 24 volts at solenoid valve(s) supply and return wire connector.	f. Proper voltage supply to solenoid valves.
	g. No voltage at solenoid valves.	g. Defective circuit between connector and valves.
	h. 24 volts at ignition unit connector.	h. Proper voltage supply to ignition unit.
	i. No voltage at ignition unit	i. Defective circuit to ignition unit.
DT 14.3 Ignition Unit Operation WARNING High Voltage: (See decal on unit) Warning Voltage High Amperage Output		

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
Manifold Heater Tests — Continued		
1. Remove high tension wire from igniter (spark plug). Position lead wire end to ground for spark gap (1/4") and press heater switch "on".	a. Note high tension spark (hot bluish-white) across gap (lead-to-ground).	a1. High tension spark indicates ignition unit operation normal. a2. Improper spark or no spark indicates ignition unit or ignition unit lead is defective.
DT 14.4 Spark Plug Operation: WARNING High Voltage		
1. Remove spark plug, reconnect wire to spark plug, ground plug body to engine and press heater switch "on".	a. Note high tension spark across spark plug electrodes.	a1. High tension spark indicates spark plug firing, operation normal. a2. No spark, the spark plug is defective.
DT 14.5 Solenoid Valve (s) Operation:		
1. Press heater switch intermittently "ON" and "OFF"	a. Note audible "click" or opening and closing valve action (by touch) of both solenoid valves (fuel supply and fuel return).	a1. Evidence of action indicates normal solenoid valve operation. a2. No audible "click" or action indicates solenoid valve(s) is defective.
DT 14.6 Fuel System Checks:		
1. Purge Pump: Disconnect purge pump fuel hose quick disconnect coupling at engine main fuel backflow valve. Hold coupling valve open and operate purge pump.	a. Note fuel with each firm stroke of purge pump.	a1. Moderate flow with each stroke indicates normal purge pump operation. a2. If flow is not evident, purge pump is defective, or purge lines are blocked or leaking.
2. Fuel Filter: Disconnect fuel tube between fuel check valve tee and manifold heater fuel filter and operate purge pump.	a. Note fuel flow with each stroke of purge pump.	a1. Moderate flow with each stroke indicates no in-line filter restriction. Filter satisfactory. a2. No flow, or restricted flow, indicates in-line filter is plugged.
3. Solenoid Valve and Fuel Filter: Disconnect one fuel tube from engine front solenoid valve outlet tee, operate purge pump and press heater switch "ON" and "OFF".	a. With switch in "ON" position, note fuel flow from tee opening with each purge pump stroke.	a1. Fuel flow indicates solenoid valve is operating properly and fuel filters are satisfactory. a2. No fuel or restricted flow indicates manifold heater filter or felt filters in solenoid valve are restricted or clogged.
	b. With switch in "OFF" position note that fuel flow stops.	b1. If fuel flow stops, solenoid valve is closing properly. b2. If fuel flow continues, solenoid valve is defective (stuck open).
4. Fuel Nozzle Assembly: Disconnect lines and remove nozzle assembly. Reconnect lines to nozzle, (position nozzle beside housing) and operate heater system.	a. With switc [illegible] "ON" position, nozzle should [illegible] ne conical fuel spray pattern	a1. Fine fuel spray pattern indicates proper nozzle operation. a2. No spray pattern, stream of fuel, dribble or no fuel indicates defective nozzle or plugged felt port filters in nozzle assembly.
5. Return Fuel Solenoid Valve and Check Valve: Remove fuel return solenoid outlet tube after the check valve at rear of engine, operate purge pump and press heater switch "ON" and "OFF".	a. With switch in "ON" position, note fuel flow from check valve opening.	a1. Moderate flow indicates solenoid valve is operating properly and check valve is opening properly. a2. No fuel or restricted flow indicates check valve stuck closed or felt filters in solenoid valve are restricted or clogged.
	b. With switch in "OFF" position note that fuel flow stops.	b1. If fuel flow stops, solenoid valve is closing properly. b2. If fuel flow continues, solenoid valve is defective (stuck in open position).

Table 2-3. Diagnostic Tests — Continued

Procedure	Observation	Analysis
DT 15. Engine Low Power Tests		
DT 15.1 High Idle (no load) Test: NOTE Use a calibrated tachometer for this test.		
1. Refer to Item 19.1 for precautionary steps to be taken before operating engine.		
2. Start engine and warm-up to normal operating temperature (140°F).		
3. With transmission in "neutral" depress accelerator pedal fully for approximately 10 seconds.	a. Engine speed 2500-2640 rpm.	a. Speed is normal and governor no-load adjustment is proper.
	b. Engine speed below 2500 rpm.	b. Speed too low.
	c. Engine speed exceeds 2640 rpm.	c. Speed too high.
DT 15.2 "Stall" Test: NOTE Use a calibrated tachometer for this test.		
1. Refer to item 19.1 for precautionary steps to be taken before operating engine. CAUTION *Do not* conduct "stall test" more than 30 seconds and/or continue "stall" if transmission oil temperature warning light comes "ON".		
2. Start engine and warm to normal operating temperature (140° F.).		
3. With vehicle brakes applied and transmission in "high range", depress accelerator pedal fully and operate engine for 20 seconds (max.); release accelerator pedal and allow engine to idle one minute.	a. Engine speed reading below 1800 rpm.	a. Engine and transmission partially warmed up (continued procedure 4).
4. Repeat 3 above, but operate engine for 30 seconds (max.).	a. Engine speed 1800-1950 rpm.	a. Engine power is normal.
	b. Engine speed below 1800 rpm.	b. Power is below normal.
	c. Engine speed above 1950 rpm.	c. Transmission is slipping or engine overfueled.

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ACCESSORIES

2-14. General

a. Sections III through VI of this chapter cover replacement of engine accessories, and removal and replacement of components related to inspection, adjustment and service operations allocated to Direct Support maintenance personnel. Some accessories, engine components or service operations can be accomplished while engine is installed in vehicle, but is dependent upon how accessible the item is. Engines which have been removed from the vehicle for accessory replacement should be thoroughly cleaned before replacement of accessory is attempted.

b. Refer to pertinent vehicle technical manuals for instructions on the removal or installation of the power plant and separation of the transmission from the engine.

2-15. Specific Instructions

a. Cleanliness. Extreme care must be exercised to insure that dust and dirt, even in minute quantities, does not enter the engine. Plug or cover all fuel and oil line connections to prevent entry of dirt. Clean parts thoroughly and coat all surfaces of bearings, shafts and contact surfaces with engine oil (OE). Surface must be protected from dirt after oiling.

b. Gaskets. Always use new gaskets and preformed packings when reinstalling engine components.

c. Torque Tightening Attaching Hardware. Apply a light film of OE engine oil or GAA grease to studs, bolt threads, capscrew threads, and contact face of nuts, bolt heads, and capscrew heads. Avoid excessive amounts of lubricant in blind tapped holes. All hardware must be torque tightened to specified limits. When a torque value is not specified in the text or on an illustration, refer to Standard Torque Values, paragraph 3-41. Special torque values are specified in the text and/or illustrations. Refer also to Special Torque Values, paragraph 3-41.

NOTE

Do not vary from torque specified. Undertorquing will result in premature failure of studs and bolts. Overtorquing can result in yielding of bolts and studs.

d. Safety Devices. Bolts and nuts must be secured with lock washers, lock nuts, tab washers, locking wire or cotter pins, when specified.

e. Removal and installation procedures for the Models AVDS-1790-2CA and AVDS-1790-2DA are the same as those listed for the Models AVDS-1790-2C and AVDS-1790-2D respectively with the exception of the Clean Air Package which is covered in Chapter 4.

Section IV. REMOVAL AND INSTALLATION OF ENGINE ACCESSORIES

2-16. General

This section covers the replacement and proper procedure and instructions for the removal and installation of any one of the engine accessories.

2-17. Fuel Pump (Models AVDS-1790-2C and AVDS-1790-2D)

a. Removal.

(1) Disconnect fuel outlet hose (1, fig. 2-9) from pump outlet adapter. Collect fuel in a suitable container and discard. Disconnect fuel pump inlet tube nuts (2). Remove two machine screws, lockwashers and one flat washer (3) and pull backflow valve away from bracket as necessary and remove fuel inlet tube.

(2) Remove fuel pump outlet adapter (4) and fuel inlet connector (5) from fuel pump. Retain adapter and connector for installation in replacement pump.

(3) Remove four self-locking nuts and flat washers (6) and remove fuel pump from pump adapter. Remove and discard fuel pump mounting gasket.

b. Installation.

NOTE

Pump replacement will be made with engine Fuel Pump Kit, Refer to TM 9-2910-213-34.

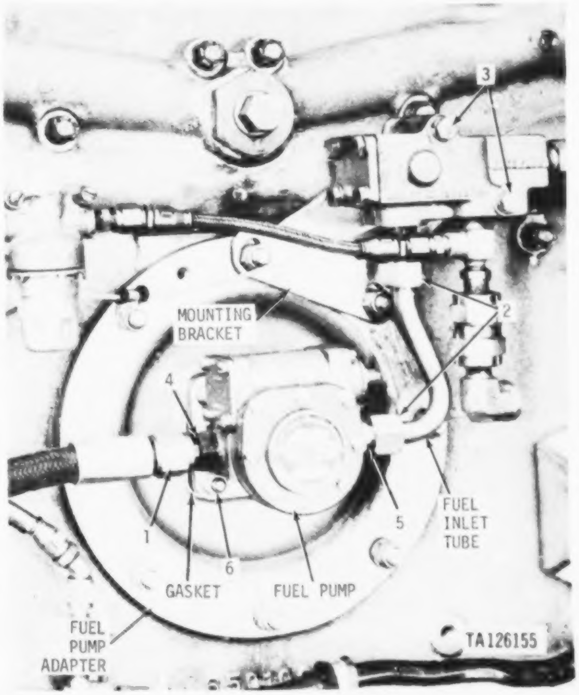
(1) Position fuel pump mounting gasket on studs and position fuel pump on pump adapter. Be sure fuel pump shaft splines are properly alined with drive coupling before securing pump to pump adapter. Install four-self-locking nuts (6, fig. 2-9) and flat washers securing pump to adapter.

(2) Install fuel inlet connector (5) and fuel pump outlet adapter (4) in fuel pump.

(3) Position fuel inlet tube between backflow valve and fuel pump. Loosely install two screws, lockwashers and one flat washer (3) securing backflow valve to mounting bracket. Connect fuel inlet tube nuts (2) to backflow valve and fuel pump. Tighten two screws (3) and connect fuel outlet hose (1) to pump outlet adapter.

NOTE

Open bleeder valve on fuel/water separator filter and purge fuel system (para 2-23). Close bleeder valve after purging system.



1 Fuel outlet hose
2 Fuel pump inlet tube nut
3 Screw, lockwasher
4 Fuel pump outlet adapter
5 Fuel inlet connector
6 Self-locking nut

Figure 2-9. Removing or installing fuel pump, model AVDS-1790-2C and AVDS-1790-2D engines.

2-17.1. Fuel Pump (Model AVDS-1790-2DR)

a. Removal.

(1) Disconnect fuel outlet hose (1, fig. 2-9.1) and fuel inlet hose (2) from respective elbows. Collect fuel in a suitable container and discard.

(2) Remove four self-locking nuts and flat washers (3) and remove fuel pump from adapter. Remove and discard fuel pump mounting gasket (4).

(3) Remove fuel inlet and outlet connectors and elbows and retain for installation on the replacement fuel pump.

b. Installation.

NOTE

Pump replacement will be made with Engine Fuel Pump Kit, refer to TM 9-2910-213-34.

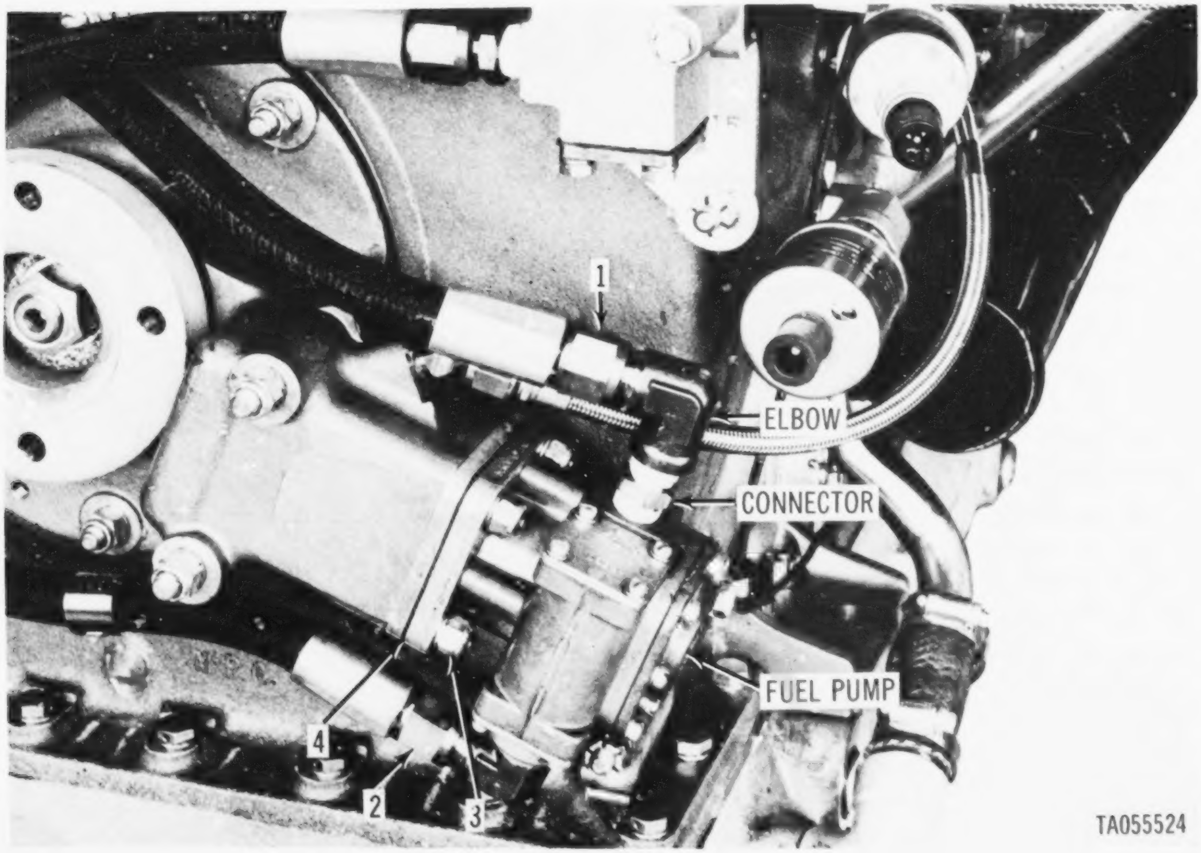
(1) Install fuel inlet and outlet connectors and elbows. Tighten elbows to position shown in figure 2-9.1.

(2) Position fuel pump mounting gasket on studs and install fuel pump on adapter. Be sure fuel pump shaft spline is properly alined before securing pump to adapter. Install four flat washers and self-locking nuts (3, fig. 2-9.1) securing pump to adapter.

(3) Connect fuel inlet hose (2) and fuel outlet hose (1) to the elbows.

NOTE

Open bleeder valve on fuel/water separator filter and purge fuel system (para 2-23). Close bleeder valve after purging system.



1 Fuel outlet hose
2 Fuel inlet hose
3 Self-locking nut and flat washer
4 Gasket

Figure 2-9.1. Removing or installing fuel pump, model AVDS-1790-2DR engine.

2-18. Starter

NOTE

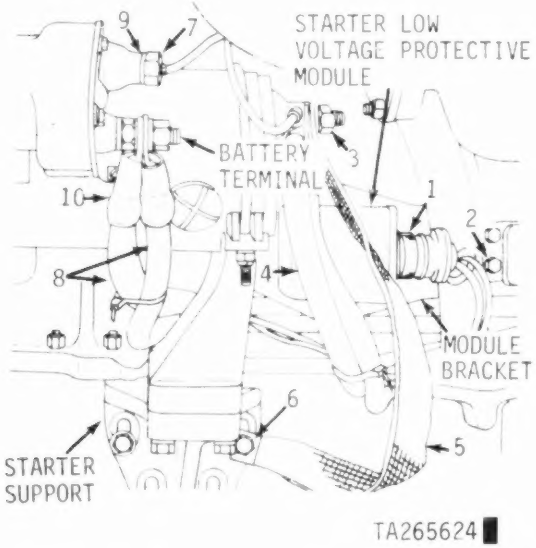
Starter removal and installation instructions for Model AVDS-1790-2DR are similar to those described below except that this engine is not equipped with an engine wiring harness.

a. Removal.

(1) Disconnect wiring harness electrical connector (1, fig. 2-10) from starter low voltage protective module. Remove machine bolt and lockwasher (2) attaching cable loop clamp to protective module bracket. Remove hexagon nut and lockwasher (3) and disconnect two wiring harness cables (4) and electrical lead (5). Install hexagon nut and lockwasher on starter terminal.

NOTE

Model AVDS-1790-2C has two starter electrical (ground) leads (5, fig. 2-10). Late model AVDS-1790-2C and AVDS-1790-2D engines have the starter low voltage protective module mounted on top of the engine. Models AVDS-1790-2D and AVDS-1790-2DR have one starter electrical (ground) lead (5).



1 Electrical connector
2 Machine bolt and lockwasher
3 Hexagon nut and lockwasher
4 Electrical cable
5 Electrical lead (ground)
6 Machine bolt and flat washer
7 Hexagon nut and lockwasher
8 Starter cable
9 Electrical lead
10 Machine screw

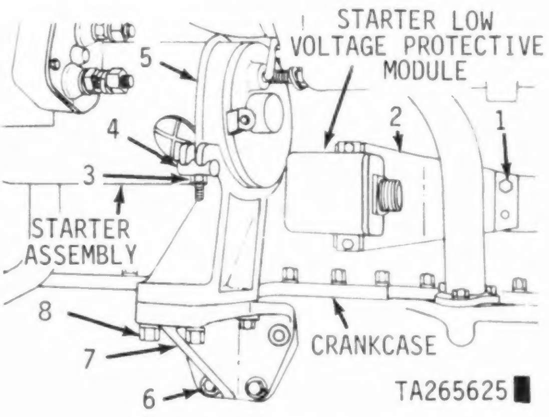
Figure 2-10. Connecting or disconnecting starter electrical leads.

(2) Remove machine bolt and flat washer (6) and remove and retain electrical lead (5) for use on replacement starter.

(3) Remove hexagon nut and lockwasher (7) and disconnect two starter cables (8) and starter low voltage protective module electrical lead (9). Install hexagon nut and lockwasher (7) on battery terminal.

(4) Remove machine screw (10) and disconnect starter low voltage protective module electrical lead. Install machine screw in starter connector.

(5) Remove three machine bolts and lockwashers (1, fig. 2-11) and remove starter low voltage protective module and bracket (2) as an assembly. Remove two self-locking nuts (3) and clamping bars (4) and remove starter retaining "U" bolt (5). Remove three machine bolts and flat washers (6) and remove starter support (7) and starter cradle as an assembly.



1 Machine bolt and lockwasher
2 Bracket
3 Self-locking nut
4 Clamping bar
5 "U" bolt
6 Machine bolt and flat washer
7 Starter support
8 Screw and flat washer

Figure 2-11. Removing or installing starter low voltage protective module and starter support.

(6) Install suitable blocks (fig. 2-12) under starter assembly for support. Remove two self-locking nuts from bolts and one self-locking nut from stud (behind starter) using open end wrench Part No. 8761568.

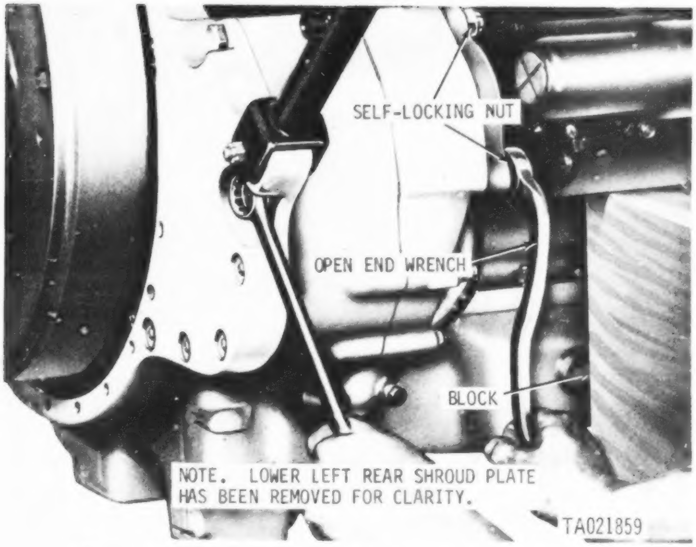

SELF-LOCKING NUT
OPEN END WRENCH
BLOCK
NOTE. LOWER LEFT REAR SHROUD PLATE HAS BEEN REMOVED FOR CLARITY.
TA021859

Figure 2-12. Removing or installing starter mounting nuts.

(7) Remove starter assembly (fig. 2-13) from starter adapter. Remove and discard mounting gasket.

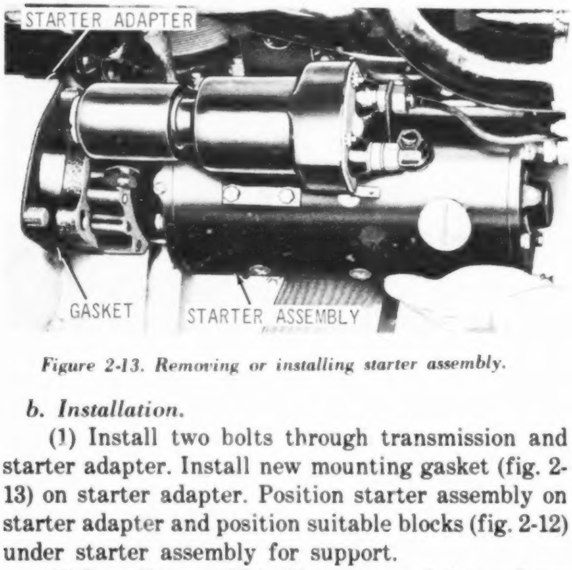


Figure 2-13. Removing or installing starter assembly.

b. Installation.

(1) Install two bolts through transmission and starter adapter. Install new mounting gasket (fig. 2-13) on starter adapter. Position starter assembly on starter adapter and position suitable blocks (fig. 2-12) under starter assembly for support.

(2) Install two self-locking nuts on bolts and one self-locking nut on stud (behind starter) using open end wrench Part No. 8761568 (fig. 2-12).

(3) Position the assembled starter support (7, fig. 2-11) and cradle on oil pan and install three bolts and flat washers. (6) Tighten only until bolt heads engage the washers (fingertight).

NOTE

It is of utmost importance that the starter support, cradle, and "U" bolt be installed in a manner that will not disturb starter mounting alinement and still furnish adequate support to minimize vibration. Misalinement of 0.010-in. in any direction is sufficient to cause a leak (pressure loss) between the starter mounting flange and the starter housing.

(4) Loosen four screws (8, fig. 2-11), allowing cradle screws to move freely in elongated holes in support. Position the "U" bolt (5) over the starter and secure to cradle with two clamping bars (4) and self-locking nuts (3). Tighten nuts evenly.

(5) Tighten four screws (8, fig. 2-11) and three machine bolts (6) securing starter support to oil pan.

(6) Position starter low voltage protective module and bracket (2, fig. 2-11) on crankcase and secure with three machine bolts and lockwashers (1).

(7) Install starter low voltage protective module electrical lead and secure to starter with machine screw (10, fig. 2-10). Install machine bolt and lockwasher (2) on cable clamp and secure to module bracket.

(8) Install starter low voltage starter protective module electrical lead (9) and two starter cables (8) on battery terminal and secure with hexagon nuts and lockwashers (7).

(9) Install two wiring harness cables (4) and electrical lead (5) on starter terminal and secure with hexagon nut and lockwasher (3). Connect wiring harness electrical lead (1) to starter low voltage protective module.

(10) Install machine bolt and two flat washers (6) on electrical lead (5) and secure to starter support.

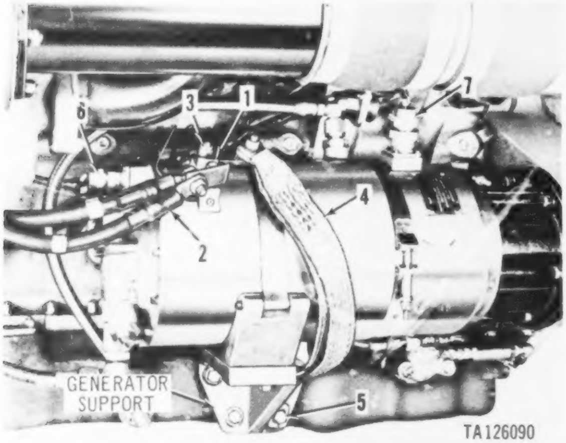
2-19. Generator

a. Model AVDS-1790-2C Engine

(1) *Removal.*

(a) Remove self-locking nut and flat washer (1, fig. 2-14) and disconnect assembled wiring harness cable (2). Install self-locking nut and flat washer. Remove self-locking nut and flat washer (3) and disconnect assembled electrical lead (ground, 4). Install self-locking nut and flat washer.

(b) Remove capscrew and two flat washers (5) and remove and retain assembled electrical lead (ground, 4) for installation on replacement generator. Disconnect wiring harness electrical leads (6) and (7).



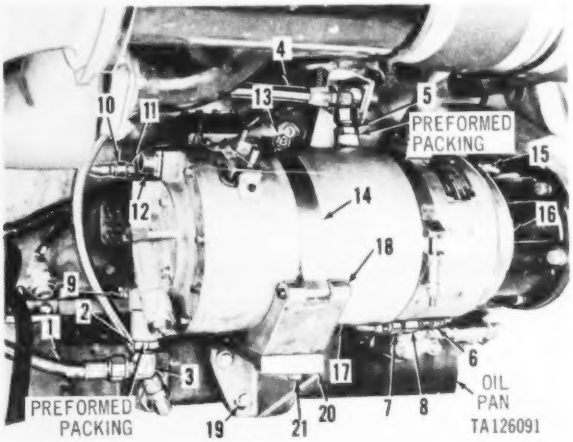
1 Self-locking nut and flat washer
2 Assembled electrical cable
3 Self-locking nut and flat washer
4 Assembled electrical lead (ground)
5 Capscrew and flat washer
6 Electrical lead (connector)
7 Electrical lead (connector)

Figure 2-14. Connecting or disconnecting generator electrical leads, model AVDS-1790-2C engine.

(*c*) Disconnect oil inlet hose (1, fig. 2-15) and drain oil into a suitable container. Loosen locking nut (2) and remove oil inlet elbow (3). Remove and discard preformed packing. Retain elbow, nut, and washer for installation in replacement generator. Disconnect oil return hose (4). Remove and retain oil return hose union (5). Remove and discard preformed packing.

(*d*) Disconnect generator rear oil drain tube (6) and front oil drain tube (7) and drain oil into a suitable container. Remove and retain oil drain tee (8) for installation in replacement generator. Disconnect and remove generator front oil drain tube and/or remove and retain front oil drain tube elbow and nipple (9). Disconnect vent hose (10). Remove and retain vent hose adapter (11) and vent restrictor (12).

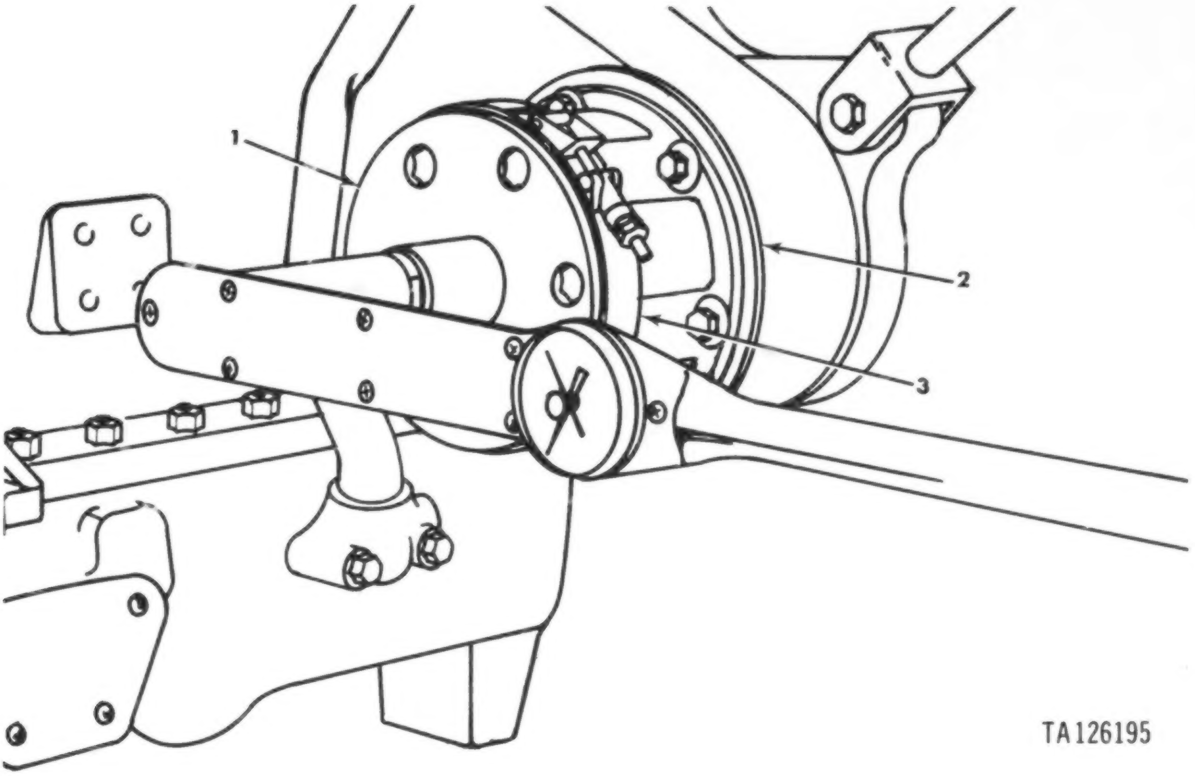
(*e*) Remove nut (13), and disengage generator cradle assembly retaining straps (14). Loosen nut (15) and remove "V" band clamp (16). Remove generator (17) from cradle assembly (18). Remove three capscrews and flat washers, (19) and remove generator support (20) and cradle as an assembly.



1 Oil inlet hose
2 Locking nut
3 Oil inlet elbow
4 Oil return hose
5 Oil return hose union
6 Rear oil drain tube
7 Front oil drain tube
8 Oil drain tee
9 Oil drain tube elbow and nipple
10 Vent hose
11 Vent hose adapter
12 Vent restrictor
13 Nut
14 Strap
15 Nut
16 "V" band clamp
17 Generator
18 Cradle assembly
19 Capscrew and flat washer
20 Support
21 Screw

Figure 2-15. Removing or installing generator, Model AVDS-1790-2C Engine.

(f) Position generator coupling tool, Part No. 11684153, on generator drive adapter (2) and secure with band clamp (3). Using suitable blocking material, block the crankshaft so it will not rotate. Using a 300 pound-feet capacity torque wrench, remove backlash and gradually increase torque to 167 pound-feet (fig. 2-15.1). If slippage occurs below 167 pound-feet, the drive gearshaft is defective and must be replaced. Check torque rotational deflection rate. Using same coupling tool and torque wrench, apply 167 pound-feet torque. Note deflection in degrees from zero torque to 167 pound-feet torque. If rotation is less than 8 degrees, or greater than 17 degrees, the drive gearshaft is defective and must be replaced.



1 Generator coupling tool
2 Generator drive adapter
3 "V" band clamp

Figure 2-15.1. Checking generator drive gear slip torque and rotational deflection.

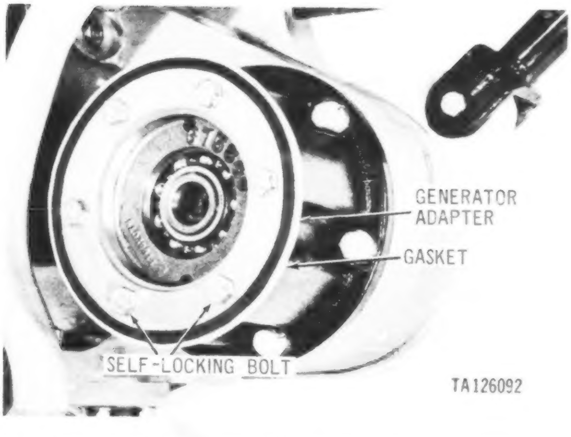


Figure 2-16. Removing or installing generator adapter.

(g) Remove six self-locking bolts (fig. 2-16) and remove generator adapter. Remove and discard mounting gasket. The adapter (fig. 2-16) must be retained for installation with replacement generator.

(h) Remove self-locking nut and flat washer located at nine o'clock position and five bolts and lockwashers (fig. 2-17) and remove generator drive adapter with drive gear shaft and bearing as an assembly. Remove and discard gasket.

(2) *Installation.*

(a) Using a new generator drive adapter gasket, install generator drive adapter (fig. 2-17) with drive gearshaft and bearing as a unit. Secure generator drive adapter assembly to crankcase assembly with five bolts and lockwashers and one self-locking nut and flat washer on stud behind adapter.

(b) Install new mounting gasket (fig. 2-16) on generator adapter. Install adapter and secure with six self-locking bolts.

(c) Install oil inlet elbow (3, fig. 2-15) and

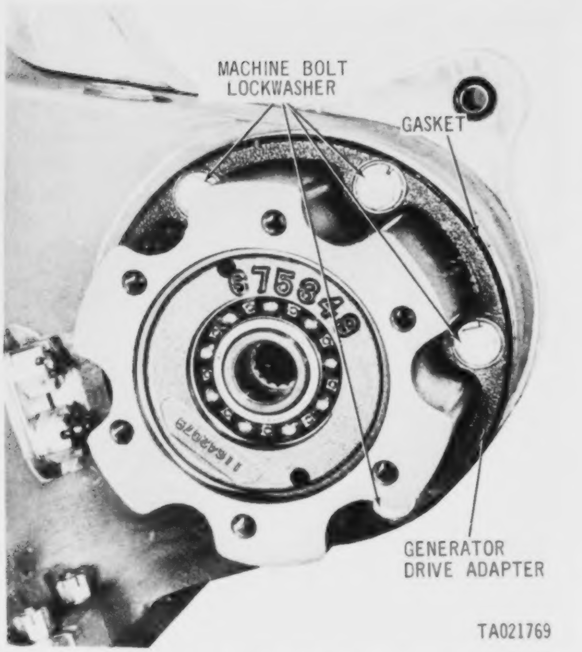


Figure 2-17. Removing or installing generator drive gear adapter and associated parts, model AVDS-1790-2C engine.

washer in generator (17) using new preformed packing and tighten locking nut (2). Install oil return hose union (5) in generator using new preformed packing. Install oil drain tee (8), drain tube elbow and nipple (9), vent restrictor (12), and vent hose adapter (11) in generator.

NOTE

It is of utmost importance that the generator support and cradle assembly be installed in a manner that will not disturb generator mounting alinement and still furnish adequate support to minimize vibration. Misalinement of 0.010-in. in any direction is sufficient to cause a leak (pressure loss) between the generator mounting flange and the generator mounting adapter.

(d) Install generator (17). Be certain generator spline is properly alined with generator drive gear assembly, and one retaining strap is located behind the generator. Install "**V**" band clamp (16) and tighten nut (15).

(e) Position the assembled generator support (20) and cradle assembly (18) on oil pan and install three capscrews and flat washers (19). Tighten screws only until heads engage washers (finger-tight). Loosen two screws (21) allowing cradle to move freely in elongated holes in the support. Position retaining straps (14) over generator and secure with nuts (13). Tighten two screws (21) securing cradle to support. Tighten three capscrews (19).

(f) Connect vent hose (10) to vent hose adapter (11), front oil drain tube to drain tube tee (8) and elbow (9), and rear oil drain tube (6) to oil drain tee (8). Connect oil return hose (4) to oil return hose union (5) and oil inlet hose (1) to oil inlet elbow (3).

NOTE

Most AVDS-1790-2C engines were built with the electrical leads (ground, fig. 2-14) secured to a common capscrew at the generator support. When installing the electrical leads (ground), each lead must be secured with an individual capscrew.

(g) Clean electrical leads (ground) terminals. Install one flat washer in the generator support upper counterbore (fig. 2-17.1). Secure the inner lead with one flat washer and capscrew. Remove lower right generator support capscrew and flat washer. Discard capscrew. Install one flat washer in generator support counterbore. Secure the outer lead with one flat washer and new capscrew (3/8-24 x 1-3/4 long). Torque tighten capscrews to 275 pound inches. Clean ground lead ends and hardware. Apply a liberal coating of silicone rubber, air-drying adhesive (MIL-A-25457) to the ground lead ends and attaching hardware. Optional materials include Dow Corning coating compound No. 3140 or RTV 3145; Dow Corning A-4000 also meets specification MIL-A-25457.

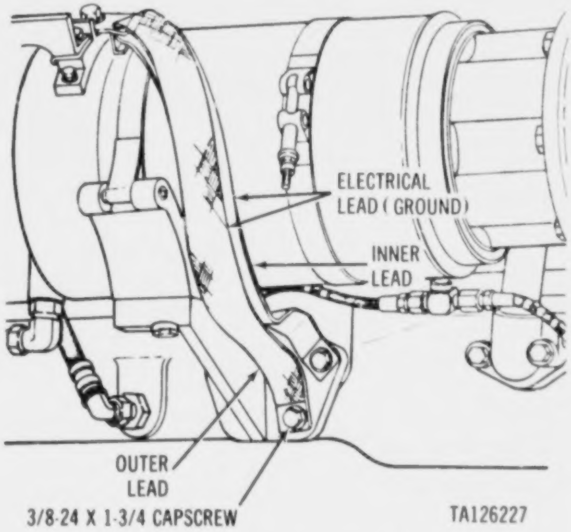


Figure 2-17.1. Installing electrical leads (ground)

(h) Connect wiring harness electrical leads (6 and 7, fig. 2-14). Install assembled electrical lead (ground, 4) on generator terminal and secure with self-locking nut and flat washer (3). Install assembled wiring harness cable (2) on generator

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terminal and secure with self-locking nut and flat washer (1).

b. Model AVDS-1790-2D and AVDS-1790-2DR engines.

NOTE

Model AVDS-1790-2DR engine generator removal and installation instructions are similar to those described below except that this engine is not equipped with an engine wiring harness.

(1) *Removal.*

(a) Remove two capscrews, lockwashers and flat washers (fig. 2-18) and remove generator air intake tube from generator blower motor housing.

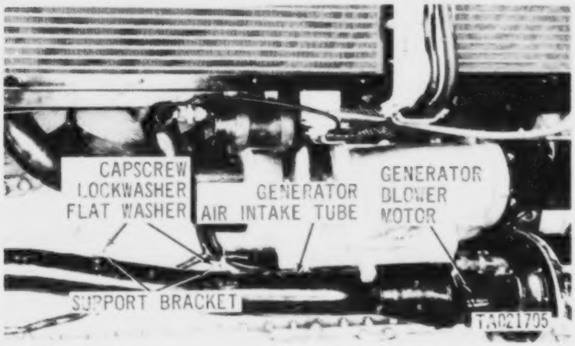


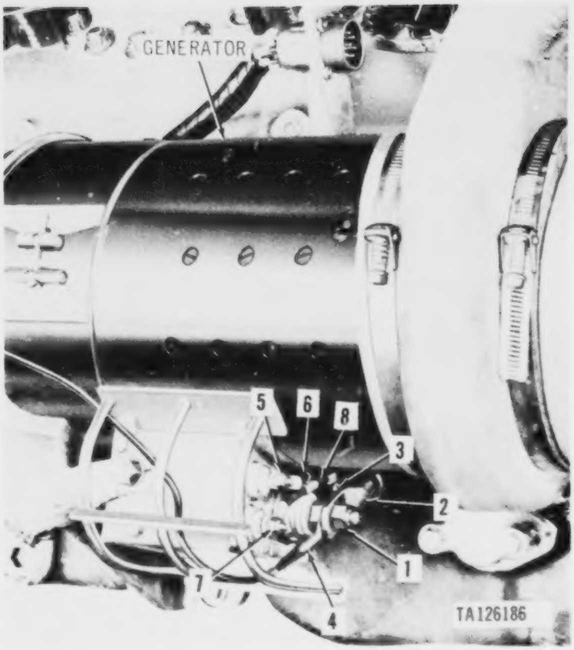
Figure 2-18. Removing or installing generator air intake tube, model AVDS-1790-2D engine.

(b) Remove self-locking nut and flat washer (1, fig. 2-19) and disconnect electrical cable (2) and electrical lead (3) and (4). Install self-locking nut and flat washer (1). Remove self-locking nut and flat washer (5) and disconnect electrical lead (6). Install self-locking nut and lockwasher (5). Remove self-locking nut and flatwasher (7) and disconnect electrical lead (8). Install self-locking nut and flatwasher (7).

(c) Remove self-locking nut and flat washer (1, fig. 2-20) and disconnect electrical lead (2). Install self-locking nut and flat washer. Remove screw and flat washer (3) and remove electrical lead. Remove capscrew and lockwasher (4) and disconnect electrical lead (5). Disconnect and remove wiring harness (6).

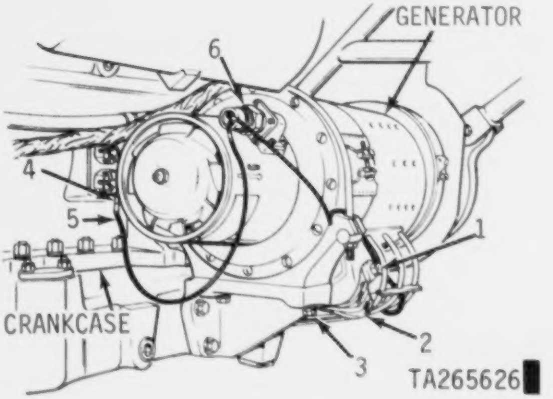
(d) Remove self-locking nut (1, fig. 2-21) and clamping bar (2). Loosen two screws (3). Remove four bolts and flat washers (4) and remove generator support (5) cradle (6) and U bolt (7) as an assembly.

(e) Loosen exhaust tube hose clamp (8) and remove two generator boot clamps (9).



1 Self-locking nut and flat washer
2 Electrical cable
3 Electrical lead
4 Electrical lead
5 Self-locking nut and flat washer
6 Electrical lead
7 Self-locking nut and flat washer
8 Electrical lead

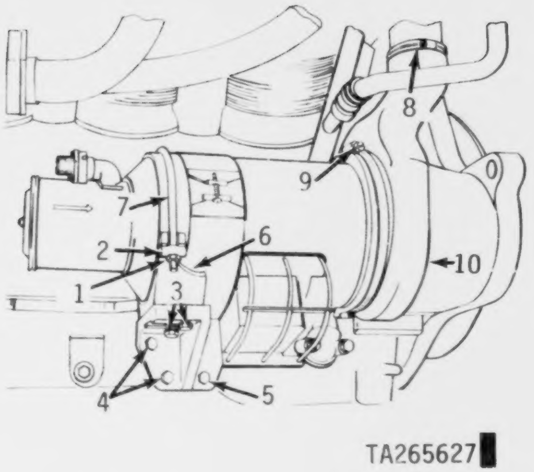
Figure 2-19. Connecting or disconnecting generator electrical leads, model AVDS-1790-2D engine.



1 Self-locking nut and flat washer
2 Electrical lead
3 Screw and flat washer
4 Capscrew and lockwasher
5 Electrical lead
6 Wiring harness

Figure 2-20. Removing or installing generator electrical lead and wiring harness, model AVDS-1790-2D engine.

(f) Slide boot back on generator far enough to expose the mounting nut access openings (fig. 2-22). Using box wrench Part No. 10935476, loosen but to not remove, six self-locking nuts to permit



1 Self-locking nut
2 Clamping bar
3 Screw
4 Bolt and flat washer
5 Support
6 Cradle
7 U bolt
8 Hose clamp
9 Boot clamp
10 Boot

Figure 2-21. Removing or installing generator, model AVDS-1790-2D and AVDS-1790-2DR engines.

rotation of generator to aline the large openings in the elongated mounting slots.

(g) Rotate generator counterclockwise until large elongated openings in flange are alined with mounting nuts and remove generator and boot. Remove boot from generator. Remove six self-locking nuts.

(2) *Installation.*

NOTE

Apply silicone compound (MIL-S-8660) to the inside of the generator boot sealing surfaces before installation.

(a) Install but do not tighten six self-locking nuts. Loosely install generator boot on generator so that the mounting access openings (fig. 2-22) are exposed. Position generator so that large elongated openings in flange are alined with mounting nuts and install generator and rotate counterclockwise and tighten six self-locking nuts using box wrench Part No. 10935476.

(b) Install exhaust tube hose clamp (8, fig. 2-21) on generator boot (10), rotate boot to position shown and tighten exhaust tube hose clamp. Install two generator boot clamps (9).

NOTE

It is of utmost importance that the generator support, cradle, and "U" bolt be installed in a manner that will not disturb generator mounting alinement and still furnish adequate support to minimize vibration. Misalinement of 0.010 in. in any direction is sufficient to cause a leak (pressure loss) between the generator mounting flange and the generator mounting adapter.

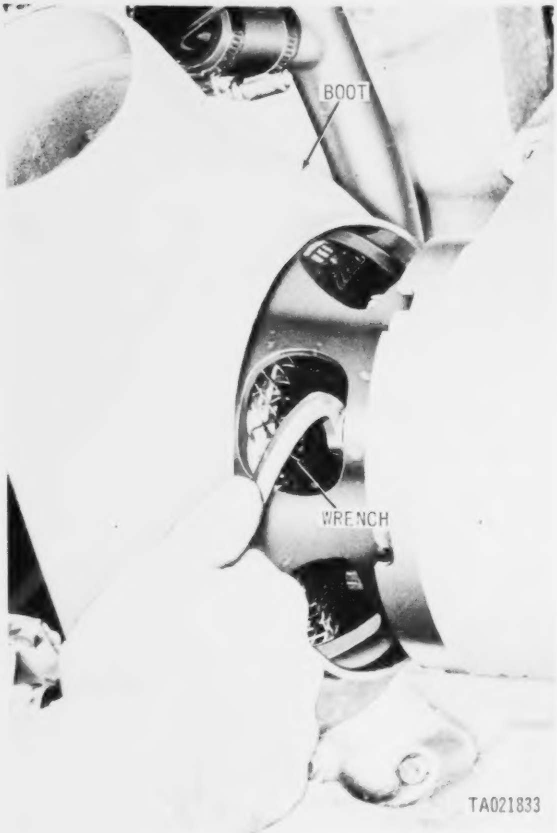


Figure 2-22. Loosening or tightening generator mounting nuts, model AVDS-1790-2D and AVDS-1790-2DR engines.

(c) Position the assembled generator cradle (6, fig. 2-21) and support (5) on the oil pan and install four bolts and flat washers (4). Tighten bolts only until heads engage washer (fingertight). Loosen two screws (3) securing cradle to support allowing cradle to move freely in elongated holes in the support. Install "U" bolt (7) over generator and secure with two clamping bars (2) and two self-locking nuts (1). Tighten two screws (3) securing cradle to support. Tighten four bolts (4).

(d) Install wiring harness (6 , fig 2-20) on blower notor connection. Install capscrew and lockwasher (4) on electrical lead (5) and secure to crankcase. Install electrical lead (2) on generator terminal and secure with self-locking nut and flat washer (1). Install electrical lead on generator cradle and secure with screw and flat washer (3).

(e) Install electrical lead from blower motor harness (4, fig. 2-19) circuit number 530 (3) and electrical cable (2) on generator terminal "B". Secure with self-locking nut and flat washer (1). Install electrical lead 478 (8) on generator terminal "D" and secure with self-locking nut and flat washer (7). Install electrical lead 1 (6) on generator terminal "A" and secure with self-locking nut and flat washer (5).

(f) Install generator air intake tube (fig. 2-18) on generator blower motor housing and secure to front and rear support brackets with two capscrews, lockwashers, and flat washers.

2-20. Turbosupercharger (Models AVDS-1790-2C and AVDS-1790-2D)

a. Removal.

NOTE

Similar procedures are required to remove the left and right turbosuperchargers. For instructional purposes, removal of the left turbosupercharger is described. Removal procedures for the right turbosupercharger are the same, except for the oil filler tube installation.

(1) Loosen two hose clamps (fig. 2-23) on oil filler tube.

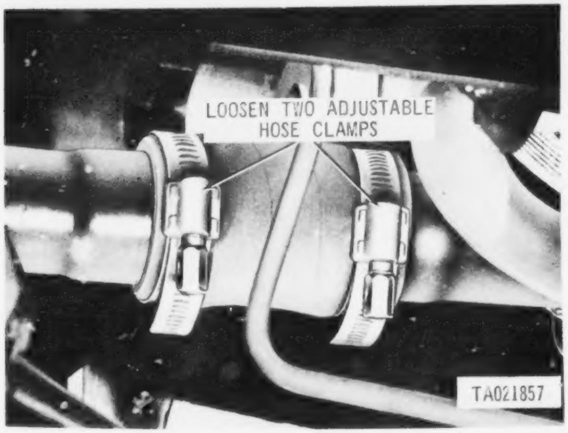


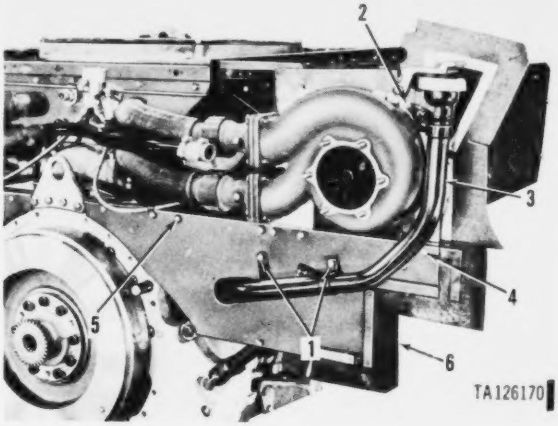
Figure 2-23. Loosening or tightening oil filler upper and lower tube hose connection, model AVDS-1790-2C and AVDS-1790-2D engines.

(2) Remove two machine bolts and lockwashers (1, fig. 2-24) and one bolt and self-locking nut (2) and remove upper oil filler tube (3).

(3) Remove one self-locking nut and machine bolt (4) and seven assembled washer bolts (5) and remove lower left rear shroud plate (6).

(4) Remove machine bolt and self-locking nut (1, fig. 2-25) and two assembled washer bolts (2), and remove turbosupercharger outer shroud plate (3).

(5) Disconnect turbosupercharger oil inlet hose (4). Remove oil inlet elbow (5) and oil inlet nipple (6) and retain for installation in replacement turbosupercharger. Remove grommet (7) and pull oil inlet hose (4) through opening in inner shroud plate.



1 Machine bolt and lockwasher
2 Machine bolt and self-locking nut
3 Upper oil filler tube
4 Machine bolt and self-locking nut
5 Assembled washer bolt
6 Lower left rear shroud plate

Figure 2-24. Removing or installing lower left rear shroud plate, and upper oil filler tube, model AVDS-1790-2C and AVDS-1790-2D engines.

(6) Remove three assembled washer bolts (fig. 2-26) and one self-locking nut and bolt, and remove inner shroud plate.

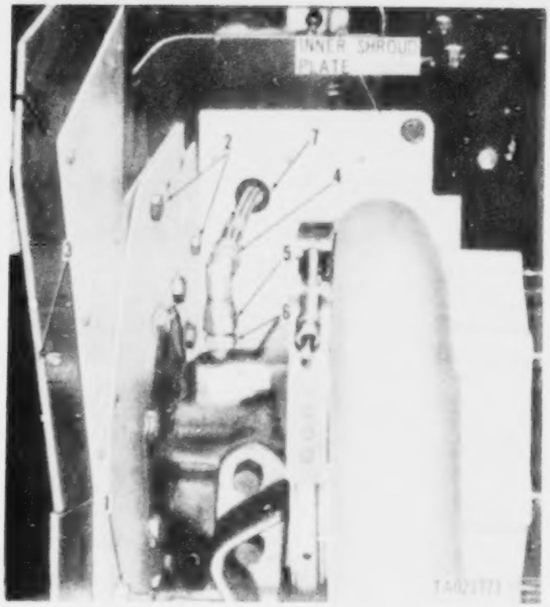
(7) Loosen self-locking nuts on hose clamps (fig. 2-27). Remove six self-locking nuts and remove air outlet elbow. Remove and discard air outlet elbow gasket. Remove two self-locking nuts and flat washers at turbosupercharger mounting base studs.

(8) Loosen two adjustable hose clamps (fig. 2-28).

(9) Remove eight self-locking nuts, flat washers and capscrews (fig. 2-29). Separate exhaust pipes from turbosupercharger and remove and discard two gaskets. Remove turbosupercharger (fig. 2-28).

b. Installation.

(1) Install turbosupercharger on mounting base studs (fig. 2-28) and insert turbosupercharger oil drain tube into oil drain tube hose. Install new gaskets (fig. 2-29) and secure exhaust pipes to turbine housing with eight self-locking nuts, flat


INNER SHROUD
PLATE
1
2
3
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5
6
7
TA021771

1 Machine bolt and self-locking nut
2 Assembled washer bolt
3 Turbosupercharger outer shroud plate
4 Oil inlet hose
5 Oil inlet elbow
6 Oil inlet nipple
7 Grommet

Figure 2-25. Removing or installing turbosupercharger outer shroud plate, oil inlet elbow and nipple, model AVDS-1790-2C and AVDS-1790-2D engines.

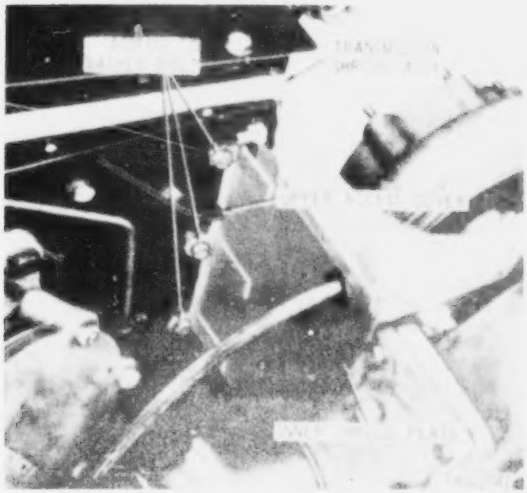

TRANSMISSION
SHROUD
UPPER ACCESS COVER
INNER SHROUD PLATE

Figure 2-26. Removing or installing inner shroud plate.

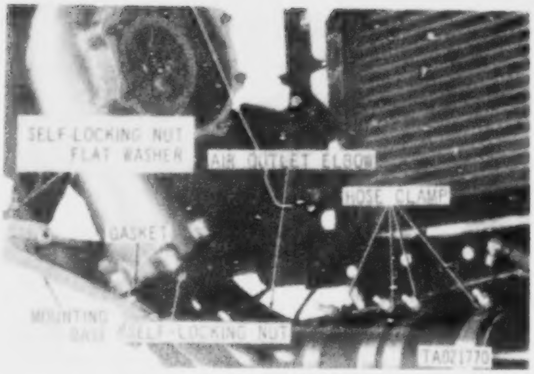

SELF-LOCKING NUT
FLAT WASHER
AIR OUTLET ELBOW
HOSE CLAMP
GASKET
MOUNTING
BASE
SELF-LOCKING NUT
TA021770

Figure 2-27. Removing or installing tubosupercharger air outlet elbow.

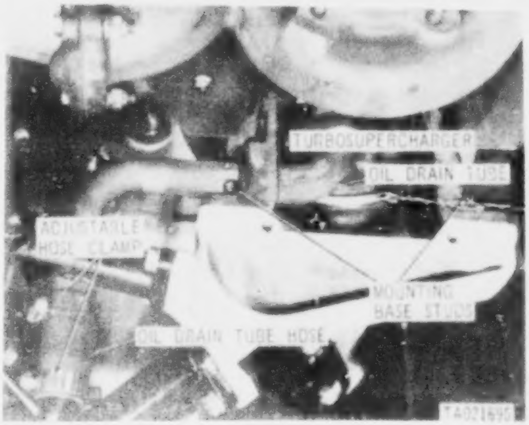

TURBOSUPERCHARGER
OIL DRAIN TUBE
ADJUSTABLE
HOSE CLAMP
MOUNTING
BASE STUDS
OIL DRAIN TUBE HOSE
TA021690

Figure 2-28. Loosening or tightening turbosupercharger oil drain tube hose connection.

washers and capscrews. Secure oil drain tube to oil drain hose with adjustable hose clamp (fig. 2-28).

(2) Secure turbosupercharger to mounting base with two self-locking nuts and flat washers (fig. 2-27). Install air outlet elbow using new gasket and secure with six self-locking nuts. Reposition and tighten hose clamps.

(3) Install inner shroud plate and secure to oil cooler frame and upper access cover with three assembled washer bolts (fig. 2-26) and one self-locking nut and machine bolt.

(4) Insert oil inlet hose (4, fig. 2-25) through opening in inner shroud plate. Install oil inlet nipple (6) and oil inlet elbow (5) in turbosupercharger and connect oil inlet hose. Install oil inlet hose grommet (7). Install outer shroud plate (3) and secure to turbosupercharger heat shield with machine bolt and self-locking nut (1) and two assembled washer bolts (2).

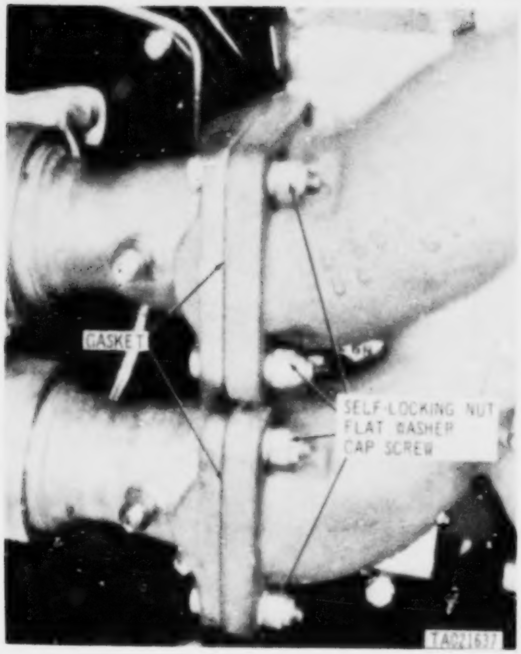


Figure 2-29. Disconnecting or connecting exhaust pipes at turbine housing.

(5) Install lower left rear shroud plate (6, fig. 2-24) and secure to lower transmission shroud, inner turbosupercharger shroud, turbosupercharger base and tie rod with seven assembled washer bolts (5) and to turbosupercharger outer shroud with one self-locking nut and bolt (4).

(6) Install upper oil filler tube (3) through lower left rear shroud plate and insert lower end of tube in hose (fig. 2-23). Secure upper oil filler tube bracket to turbosupercharger outer shroud plate with one machine bolt and self-locking nut (2, fig. 2-24) and to turbosupercharger base and tie rod with two machine bolts and lockwashers (1). Tighten hose clamps (fig. 2-23).

2-20.1. Turbosupercharger (Model AVDS-1790-2DR)

a. Removal

NOTE

Similar procedures are required to remove the left and right turbosuperchargers. For instructional purposes, removal of the left turbosupercharger is described. Removal procedures for the right turbosupercharger are the same, except for the oil filler tube installation.

(1) Loosen hose clamp (1, fig. 2-29.1) on oil filler tube hose. Remove capscrew and self-locking nut (2) securing upper oil filler tube to upper support. Remove capscrew and self-locking nut (3) securing tube to lower support, and remove the upper oil filler tube (4). Install protective cover on lower oil filler tube opening.

(2) Disconnect turbosupercharger oil inlet hose (4, fig. 2-25). Remove oil inlet elbow (5) and oil inlet nipple (6) and retain for installation in replacement turbosupercharger.

(3) Loosen self-locking nuts on hose clamps (fig. 2-27). Remove six self-locking nuts and remove air outlet elbow. Remove and discard air outlet elbow gasket. Remove two self-locking nuts and flat washers at turbosupercharger mounting base studs (fig. 2-27).

(4) Loosen upper adjustable hose clamps (fig. 2-28).

(5) Remove eight self-locking nuts, flat washers and capscrews (fig. 2-29.2). Remove upper oil filler tube support and separate exhaust pipes from turbosupercharger. Remove and discard two gaskets. Remove turbosupercharger.

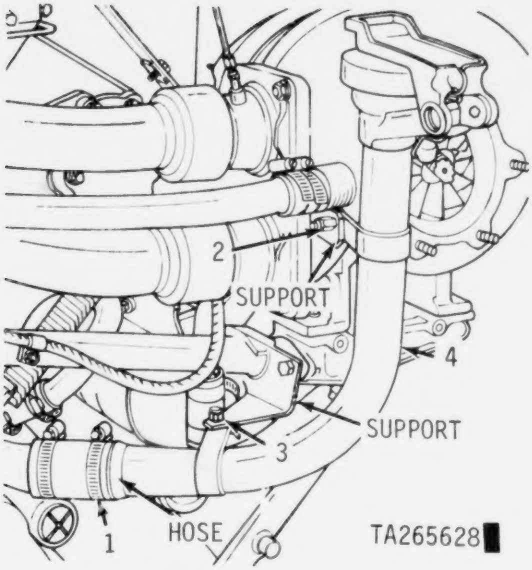
b. Installation.

(1) Install turbosupercharger on mounting base studs (fig. 2-28) and insert turbosupercharger oil drain tube into oil drain tube hose. Install new gaskets (fig. 2-29). Position upper oil filler tube support as shown in figure 2-29.2 and secure support and exhaust pipes to turbine housing with eight self-locking nuts, flat washers and capscrews. Tighten upper oil drain hose clamp (fig. 2-28).

(2) Secure turbosupercharger to mounting base with two self-locking nuts and flat washers (fig. 2-27). Install air outlet elbow using new gasket and secure with six self-locking nuts. Reposition and tighten hose clamps.

(3) Install oil inlet nipple (6, fig. 2-25) and oil inlet elbow (5) in turbosupercharger and connect oil inlet hose.

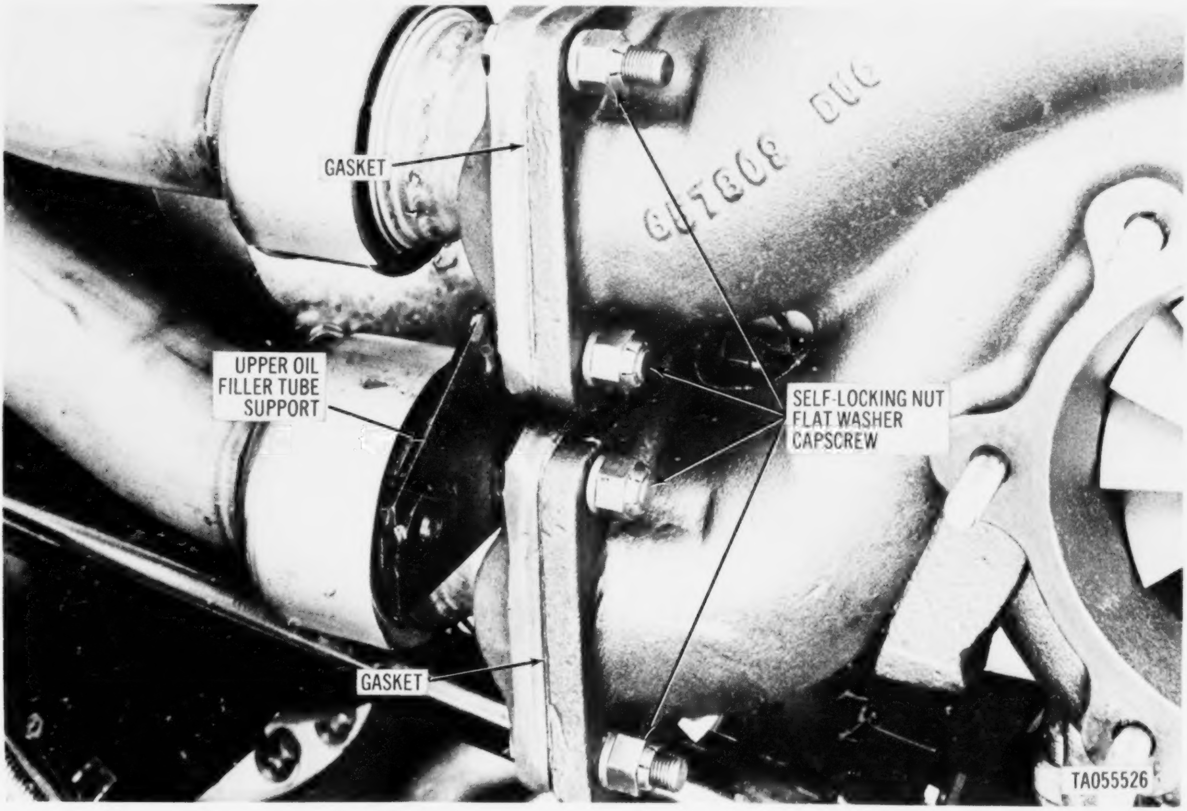
(4) Remove protective cover and install upper oil filler tube in oil filler tube hose (fig. 2-29.1). Secure the upper oil filler tube to the upper support with one capscrew and self-locking nut (2). Secure the tube to the lower support with one capscrew and self-locking nut (3). Tighten hose clamp (1).



SUPPORT
SUPPORT
HOSE
1
2
3
4
TA265628

1 Hose clamp
2 Capscrew and self-locking nut
3 Capscrew and self-locking nut
4 Upper oil filler tube

Figure 2-29.1. Removing or installing upper oil filler tube model AVDS-1790-2DR engine.



GASKET
UPPER OIL FILLER TUBE SUPPORT
SELF-LOCKING NUT
FLAT WASHER
CAPSCREW
GASKET
TA055526

Figure 2-29. 2. Disconnecting or connecting exhaust pipes at turbine housing, model AVDS-1790-2DR engine.

2-21. Fuel Injection Pump

a. Removal.

(1) Remove two machine bolts and lockwashers (1, fig. 2-30) and two capscrews and lockwashers (2) and remove cooling fan vane from front fan housing (3).

(2) Remove two machine bolts and lockwashers (4) and two capscrews and lockwashers (5), and remove cooling fan vane (6) from rear fan housing (7).

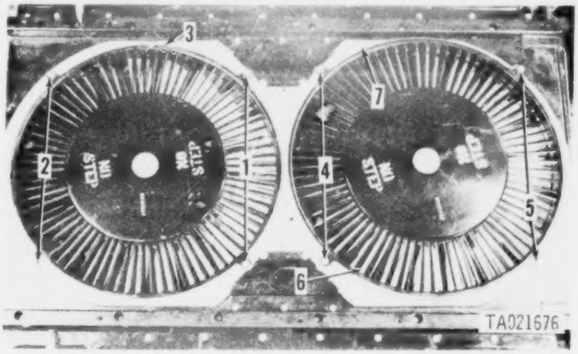
NOTE

Model AVDS-1790-2DR is not equipped with an engine wiring harness, nor an oil sampling system on the right bank oil coolers.

(3) Remove four assembled washer bolts (1, fig. 2-31) securing wiring harness bracket (2) to right front upper cover. Remove two capscrews and lockwashers (6) and retaining strap (7) from cable bracket. Set cable bracket assembly aside. Remove two assembled washer bolts (3) securing oil sampling valve bracket (4) to right rear upper cover. Remove four assembled washer bolts and four loop clamps (5) from the right upper covers. Set oil sampling system aside for cover removal.

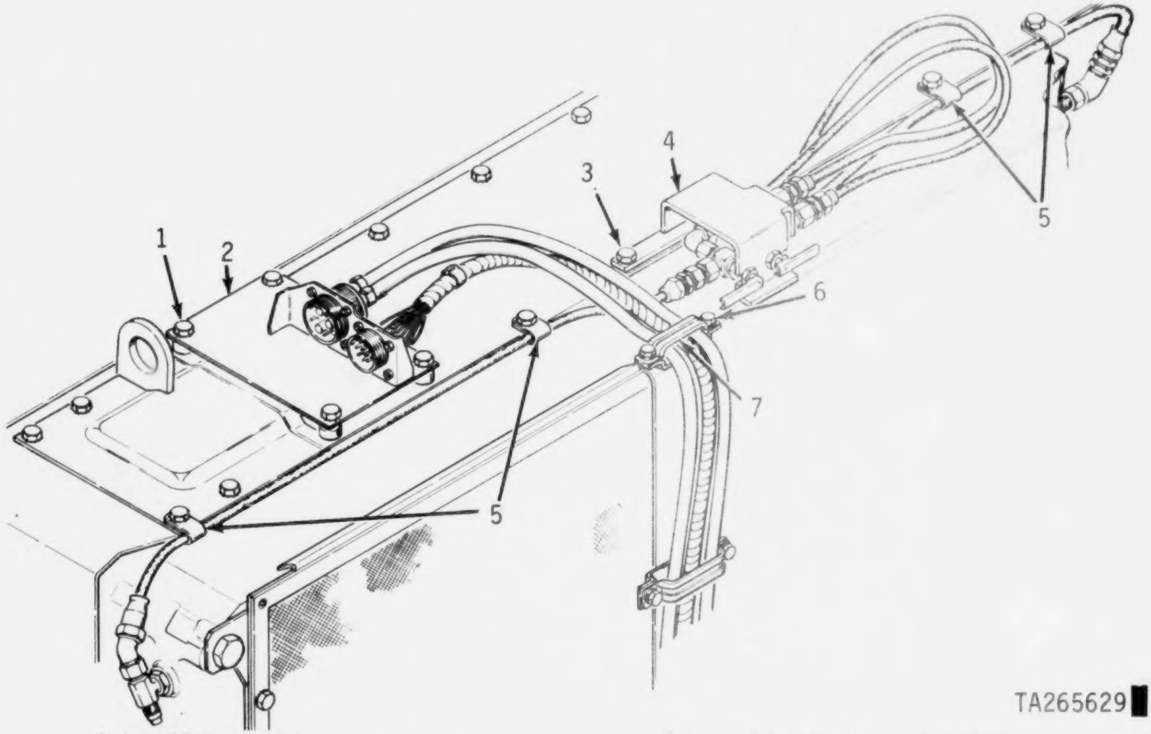
(4) At left bank oil cooler, remove two capscrews and lockwashers (6, fig. 2-31.1) from top retaining strap (7) on side cable mounting bracket. Remove retaining strap and loop clamp (8).

Figure 2-29.3. deleted.



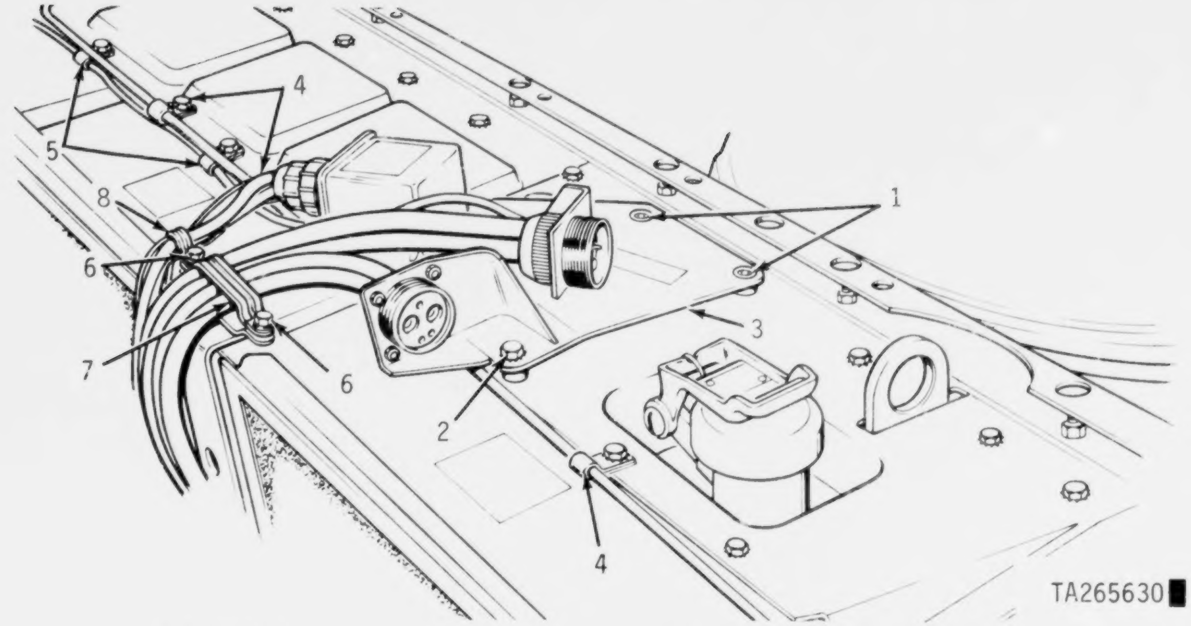
1 Bolt and lockwasher
2 Capscrew and lockwasher
3 Front fan housing
4 Bolt and lockwasher
5 Capscrew and lockwasher
6 Cooling fan vane
7 Rear fan housing

Figure 2-30. Removing or installing cooling fan vanes.



1 Assembled washer bolt
2 Wiring harness bracket
3 Assembled washer bolt
4 Oil sampling valve bracket
5 Assembled washer bolt and loop clamp
6 Capscrew and lockwasher
7 Retaining strap

Figure 2-31. Removing and installing oil sampling system.



1 Socket head capscrew
2 Assembled washer bolt
3 Cable bracket
4 Assembled washer bolt and loop clamp
5 Assembled washer bolt and loop clamp
6 Capscrew and lockwasher
7 Retaining strap
8 Loop clamp

Figure 2-31.1. Removing or installing left wiring harness cable bracket, model AVDS-1790-2C and AVDS-1790-2D late engines.

(4.1) On early engines, remove four capscrews and lockwashers (fig. 2-32) and remove assembled wiring harness cable bracket from left front upper cover. Set aside.

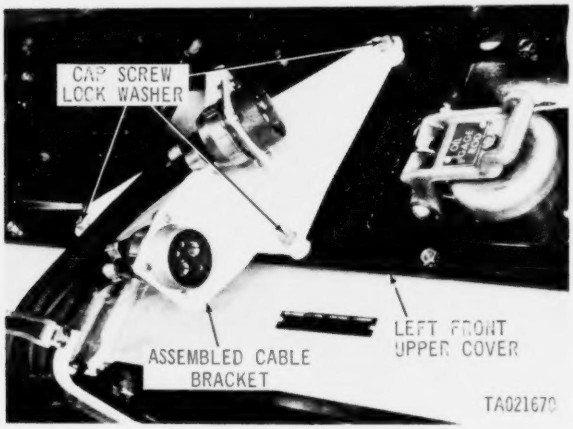


Figure 2-32. Removing or installing left wiring harness cable bracket, model AVDS-1790-2C and AVDS-1790-2D early engines.

(4.2) On late engines remove two assembled washer bolts and loop clamps (5, fig. 2-31.1) securing smoke generating system electrical lead to left rear upper cover. Remove two socket head capscrews (1), three assembled washer bolts (2) and loop clamp. Assembled harness cable bracket (3) is now loose.

(4.3) Remove three assembled washer bolts attaching three loop clamps (4, fig 2-31.1) for the smoke generating fuel tube to the left upper covers.

(4.4) On Model AVDS-1790-2DR remove four assembled washer bolts attaching four loop clamps for smoke generating fuel tube (fig. 2-32.1).

(5) Remove cotter pin, slotted nut and flat washer (1, fig. 2-33). Discard cotter pin. Remove front cooling fan and hub assembly (2) from vertical drive shaft. Remove rear cooling fan and hub assembly (3) in the same manner.

(6) Remove 12 self-locking nuts and flat washers (4) and two assembled washer bolts (right side only) attaching cooling fan shroud to top frame. Open gage rod tube cap (5) and remove oil gage indicator rod. Remove 12 remaining assembled washer bolts (6) and remove left rear upper cover (7) and left front upper cover (8) with oil level tube cap assembly attached. Remove and discard two preformed packings from the oil filler tube neck. Remove 12 remaining assembled washer bolts (9) and remove right rear upper cover (10) and right front upper cover (11).

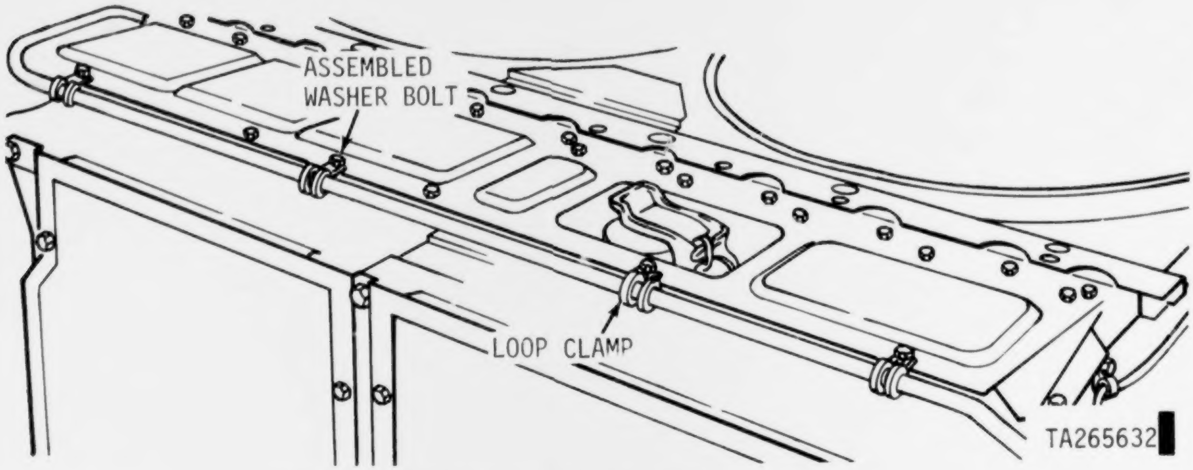
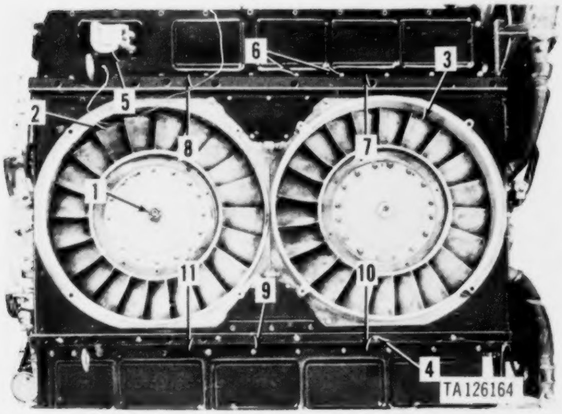


Figure 2-32.1. Removing or installing smoke generating system fuel hose loop clamps, model AVDS-1790-2DR engine.



1 Cotter pin, slotted nut and flat washer
2 Front cooling fan and hub assembly
3 Rear cooling fan and hub assembly
4 Self-locking nut and flat washer
5 Oil gage rod tube cap
6 Assembled washer bolt
7 Left rear upper cover
8 Left front upper cover
9 Assembled washer bolt
10 Right rear upper cover
11 Right front upper cover

Figure 2-33. Removing or installing cooling fan upper covers, model AVDS-1790-2C and AVDS-1790-2D engines.

(6.1) On Model AVDS-1790-2DR open oil gage rod tube cap (1, fig. 2-33.1) and remove oil gage indicator rod. Remove 12 self-locking nuts and flat washers (2) and four assembled washer bolts (3) attaching cooling fan shroud to top frame. Remove two assembled washer bolts (4) and remove retaining strap (5). Remove eight assembled washer bolts (6) and lift left front upper cover assembly (7), with oil level indicator tube cap attached, from the oil level indicator tube assembly. Remove and discard the two preformed packings from the tube cap neck. Remove eight assembled washer bolts and remove the left rear upper cover (8). Remove five assembled washer bolts (9) and remove cover adapter (10). Remove 10 assembled washer bolts (11) and remove right rear upper cover (12). Remove 12 assembled washer bolts (13) and remove right front upper cover (14).

(7) Remove five assembled washer bolts and two loop clamps (fig. 2-34) attaching cooling fan shroud to left and right front shroud.

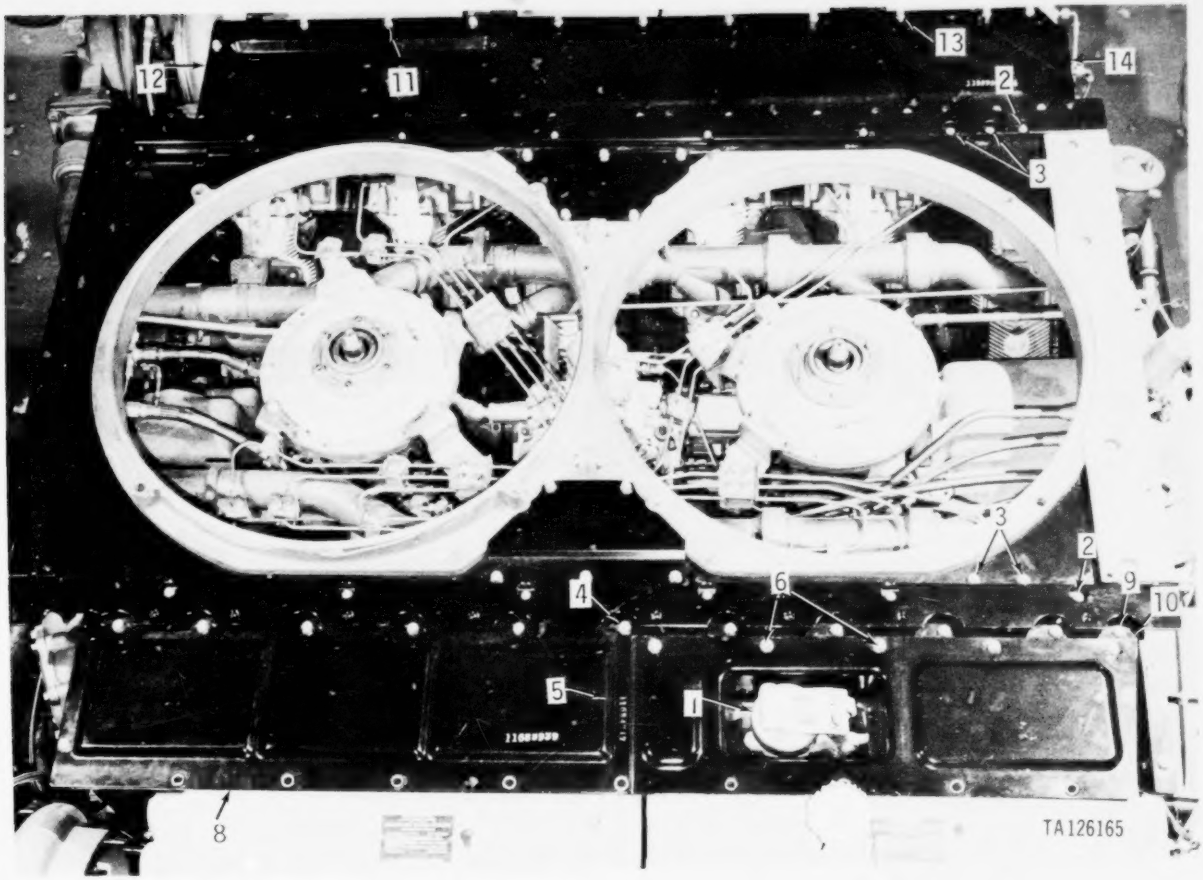
(8) At rear of engine remove four self-locking nuts (not shown) and four assembled washer bolts (1, fig. 2-35), securing the fuel return tube clamps to the inside of the shroud. Remove the three remaining assembled washer bolts (2) securing the cooling fan shroud to the rear shrouds. Remove cooling fan shroud and fan housing.

(9) Remove 12 self-locking nuts (not shown) and machine bolts (fig. 2-36) and associated plates and clamps from left bank injector tube clamp supports at No. 1L through 6L cylinders (1, fig. 2-37). Remove clamps from supports at No. 1R through 6R cylinders in the same manner.

(10) Remove eighteen self-locking nuts and machine bolts (1, fig. 2-37) and associated plates and clamps from fuel injector tube clamp brackets (2). Remove twelve self-locking nuts and machine bolts (3) and associated plates and clamps from fuel injector tubes. Remove two self-locking bolts (4) and remove plate and clamps from fuel injector tube clamp bracket.

(11) Using crowfoot adapter, loosen 12 fuel injector support nuts (fig. 2-38) and disconnect 12 fuel injector tube nuts from fuel injector nozzles.

(12) Loosen 12 fuel injector support nuts (fig. 2-39) and disconnect 12 fuel injector tube connectors from fuel injection pump. Remove fuel injector tubes and install caps (1, fig. 2-40) in fuel injection pump tube openings.


12
11
13
14
2
3
3
2
9
10
6
4
5
1
8
TA126165

1 Oil gage rod tube cap
2 Self-locking nut and flat washer
3 Assembled washer bolt
4 Assembled washer bolt
5 Retaining strap
6 Assembled washer bolt
7 Left front upper cover assembly
8 Left rear upper cover
9 Assembled washer bolt
10 Cover adapter
11 Assembled washer bolt
12 Right rear upper cover
13 Assembled washer bolt
14 Right front upper cover

Figure 2-33.1. Removing or installing cooling fan upper covers, model AVDS-1790-2DR engine.

Figure 2-33.2. Deleted

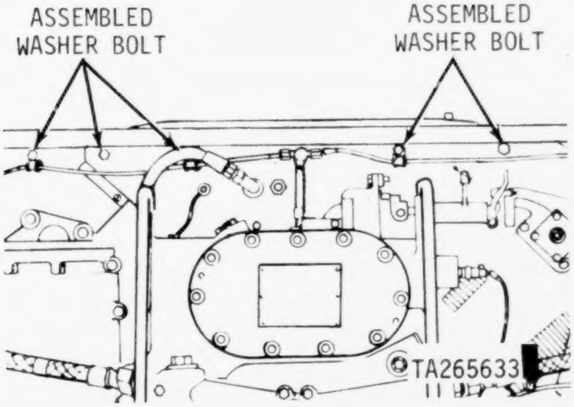
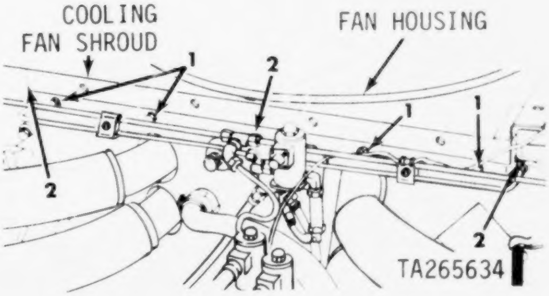

ASSEMBLED WASHER BOLT
ASSEMBLED WASHER BOLT
TA265633

Figure 2-34. Disconnecting or connecting front end of cooling fan shroud.


COOLING FAN SHROUD
FAN HOUSING
1
2
2
1
1
2
TA265634

1 Assembled washer bolt, flat washer, hexagon nut
2 Assembled washer bolt

Figure 2-35. Disconnecting or connecting rear end of cooling fan shroud, model AVDS-1790-2C and AVDS-1790-2D engines.

Figure 2-35.1. Deleted

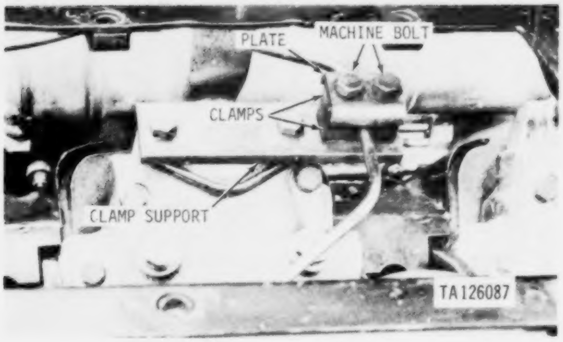


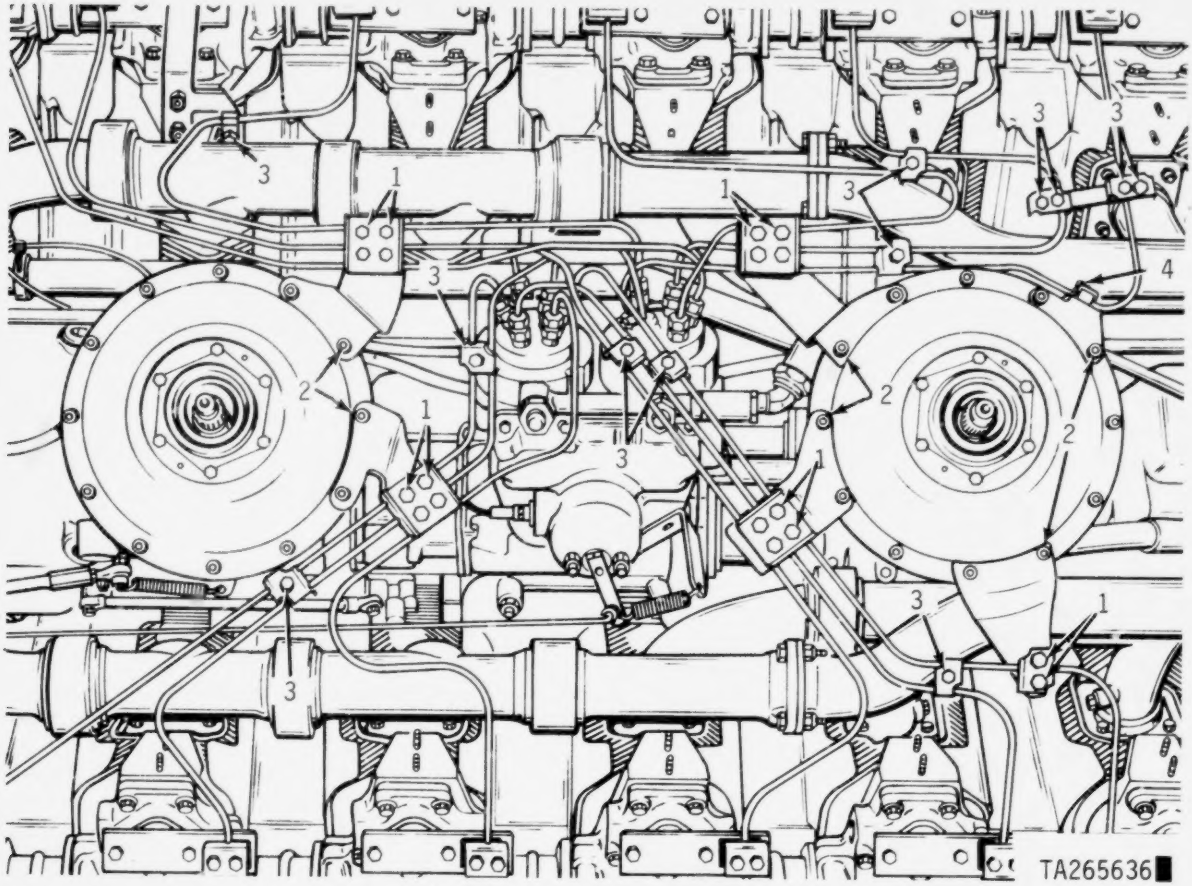
Figure 2-36. Removing or installing fuel injector left and right bank tube clamps from clamp supports.

(13) Disconnect electrical lead (2, fig. 2-40). Disconnect oil inlet hose (3) and fuel inlet hose (4) from adapters. Disconnect fuel return hose (5) from check valve (6). Remove and retain check valve for use in replacement pump.

NOTE

> Model AVDS-1790-2DR engine fuel return check valve and elbow are routed around the right side of the rear fan drive housing. However, disconnect and connect procedures are identical.

(14) Remove cotter pin and flat washer (1, fig. 2-41), and separate manual fuel shutoff rod assembly (2) from lever. Discard cotter pin. Disconnect spring (3) from lever. Remove and retain for installation on replacement injection pump, two



1 Self-locking nut and machine bolt
2 Tube clamp bracket
3 Self-locking nut and machine bolt
4 Self-locking bolt

Figure 2-37. Removing or installing fuel injector tube clamp from injector tubes and brackets.

Figure 2-37.1. Deleted

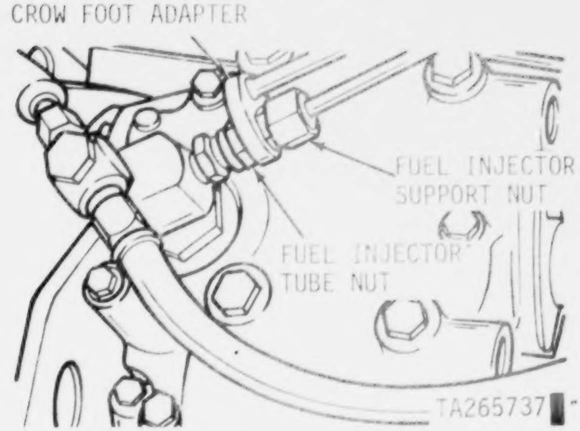


Figure 2-38. Disconnecting or connecting fuel injector tube nuts.

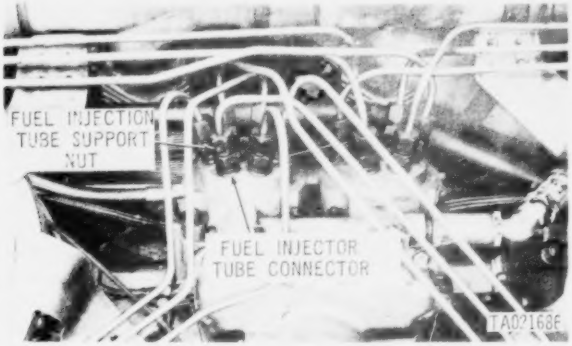
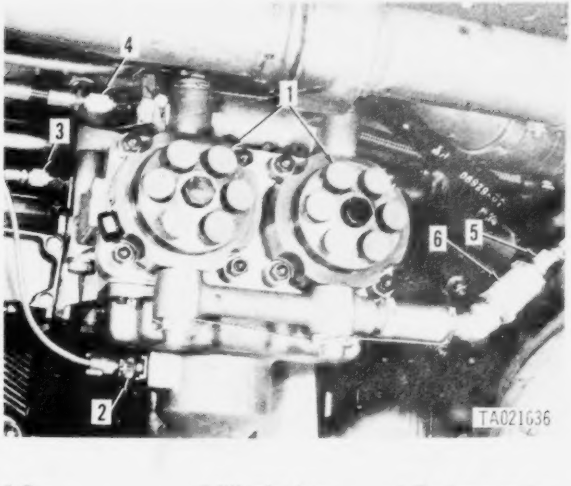


Figure 2-39. Removing or installing fuel injector tubes from fuel injection pump.

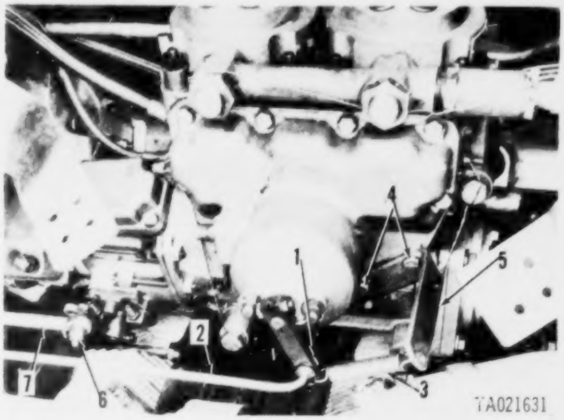


1 Cap
2 Electrical lead
3 Oil inlet hose
4 Fuel inlet hose
5 Fuel return hose
6 Check valve

Figure 2-40. Disconnecting or connecting electrical lead and fuel and oil hoses.

capscrews and lockwashers (4), spring angle bracket (5) and spring (3). Remove self-locking nut, washer, and machine bolt (6) and separate throttle control rod assembly (7) from injection pump.

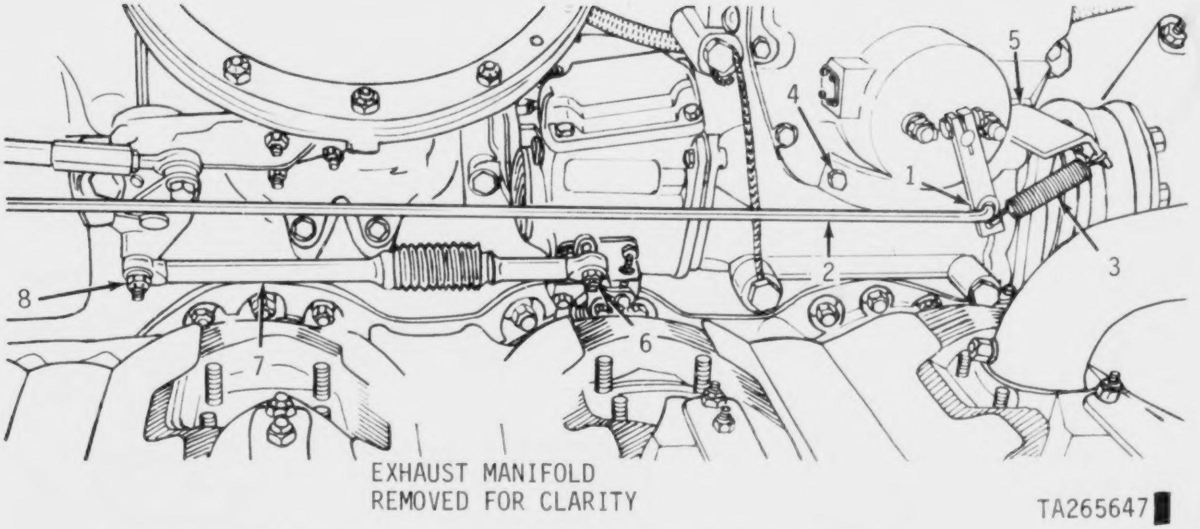
(14.1) Remove cotter pin and flat washer (1, fig. 2-41.1), and separate manual fuel shut-off rod assembly (2) from lever. Discard cotter pin. Remove spring (3) from lever and angle bracket. Remove three capscrews and lockwashers (4) and remove angle bracket (5) from fuel injection pump. Retain spring (3), capscrews and lockwashers (4) and angle bracket (5) for installation on the replacement fuel injection pump. Remove self-locking nut, flat washer and machine bolt (6) and separate throttle control rod assembly (7) from fuel injection pump lever. Remove self-locking nut, flat washer and machine bolt (8) and remove throttle control rod assembly (7).



1 Cotter pin and flat washer
2 Manual fuel shut-off rod assembly
3 Spring
4 Capscrew and lockwasher
5 Spring angle bracket
6 Self-locking nut, washer and machine bolt
7 Tnrottle control rod assembly

Figure 2-41. Disconnecting or connecting manual fuel shut-off rod, throttle control rod, and spring angle bracket, model AVDS-1790-2C and AVDS-1790-2D engines.

(15) Turn flywheel using splined wrench, part No. 10882747 (fig. 2-42), until fuel injection pump coupling (fig. 2-43) is positioned as shown. Stamp identification marks on both coupling sleeves. Remove four bolts and lockwashers (fig. 2-43), and associated lock plates and separate coupling sleeves.



1	Cotter pin and flat washer
2	Manual fuel shut-off rod assembly
3	Spring
4	Capscrew and lockwasher
5	Angle bracket
6	Self-locking nut, flat washer and machine bolt
7	Throttle control rod assembly
8	Self-locking nut, flat washer and machine bolt

Figure 2-41.1. Disconnecting or connecting manual fuel shut-off rod, throttle rod and associated parts, model AVDS-1790-2DR engine.

NOTE

The fuel injection pump coupling sleeves and hubs must be identified with identical marks (fig. 2-43) to prevent mismating of parts. The sleeves and hubs are matched for each assembly and must not be interchanged between assemblies.

(15.1) Position improvised engine turning tool (1, fig. 2-42.1) on power take-off coupling and secure with four 7/16-20UNF x 1 ½-inch machine bolts (2). Install a 1 ¼-inch socket (3) and turn crankshaft until fuel injection pump coupling is positioned as shown in figure 2-43. Stamp identification marks on both coupling sleeves. Remove four bolts and lockwashers (fig. 2-43) and lock plates and separate coupling sleeves.

NOTE

The fuel injection pump coupling sleeves and hubs must be identified with identical marks (fig. 2-43) to prevent mismating of parts. The sleeves and hubs are matched for each assembly and must not be interchanged between assemblies.

(16) Cut locking wire (fig. 2-44) and remove three machine bolts and plain washers. Loosen lower rear bolt until threads are free. Bolt cannot be removed until after fuel injection pump is removed from engine. Remove fuel injection pump from mounting base. Remove and discard preformed packing from mounting base oil transfer tube. Remove bolt and plain washer.

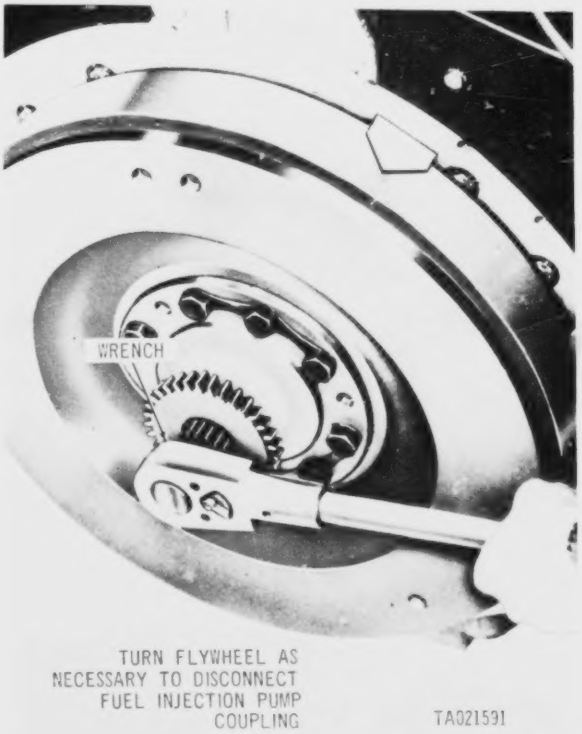
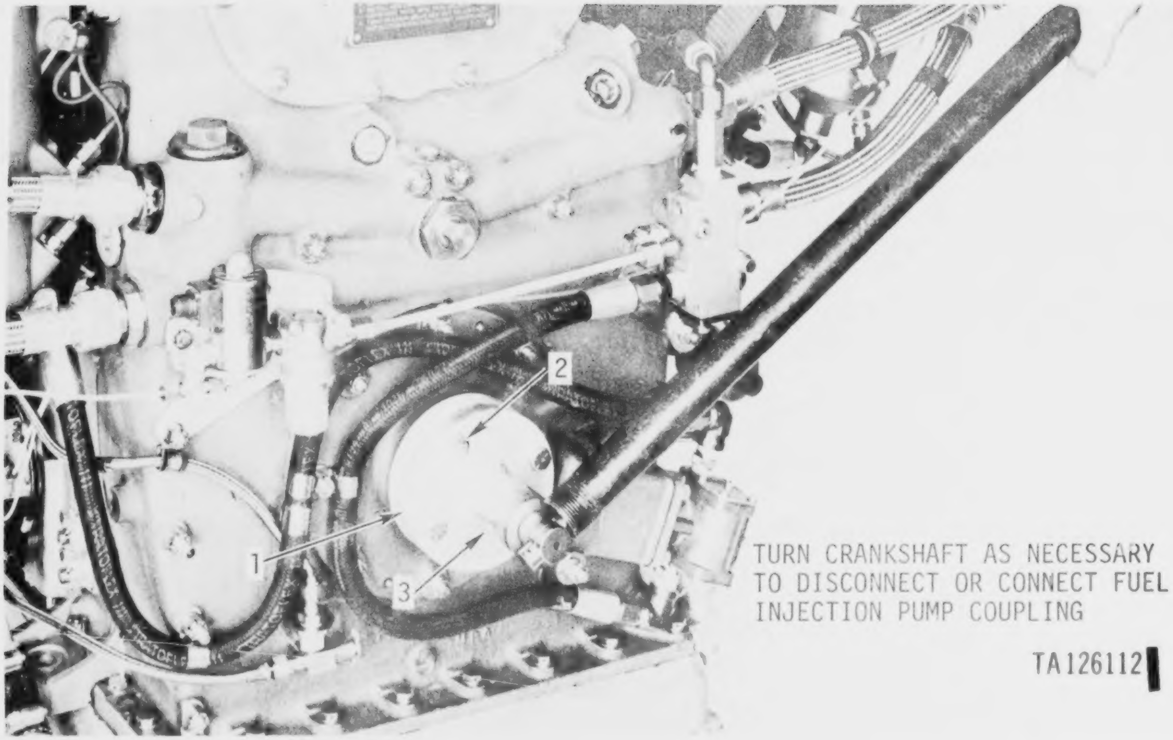


Figure 2-42. Turning flywheel using splined wrench, model AVDS-1790-2C and AVDS-1790-2D engines.


2
1
3
TURN CRANKSHAFT AS NECESSARY TO DISCONNECT OR CONNECT FUEL INJECTION PUMP COUPLING
TA126112

1 Turning tool
2 Machine bolt
3 Socket

Figure 2-42.1. Positioning fuel injection pump coupling by turning crankshaft using improvised turning tool, model AVDS-1790-2DR engine.

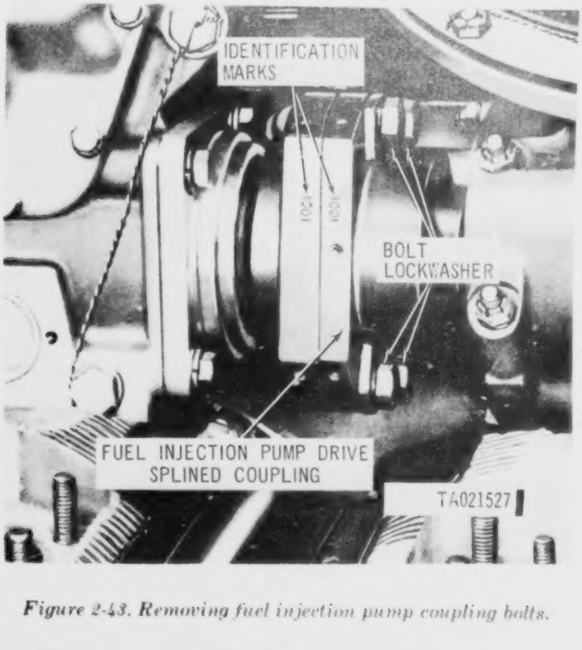

IDENTIFICATION MARKS
BOLT
LOCKWASHER
FUEL INJECTION PUMP DRIVE SPLINED COUPLING
TA021527

Figure 2-43. Removing fuel injection pump coupling bolts.

NOTE

Plug or cap fuel and oil openings in pump.

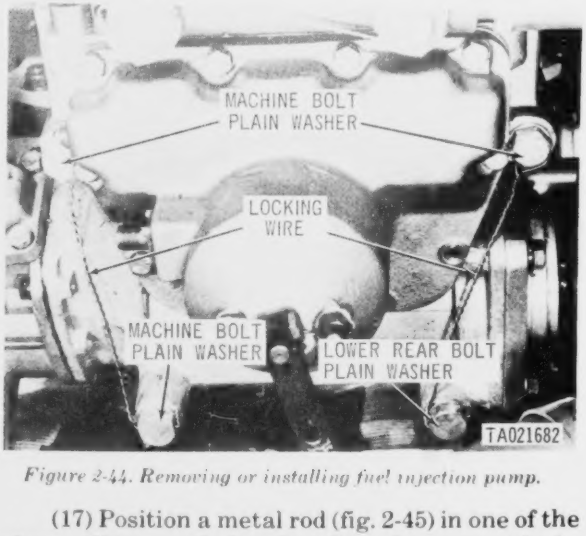

MACHINE BOLT
PLAIN WASHER
LOCKING WIRE
MACHINE BOLT
PLAIN WASHER
LOWER REAR BOLT
PLAIN WASHER
TA021682

Figure 2-44. Removing or installing fuel injection pump.

(17) Position a metal rod (fig. 2-45) in one of the sleeve alinement holes. Coupling sleeve must be in

a rigid position to remove nut. Remove plain nut and lockwasher.

NOTE

The nut, lockwasher, and key are part of the pump assembly and must be installed on pump after hub is removed.

CAUTION

The coupling halves are a matched set. Damage or wear to the sleeve or hub of either coupling half requires the replacement of a complete coupling assembly.

(18) Remove fuel injection pump front coupling sleeve and hub from injection pump shaft using a suitable puller (fig. 2-46).

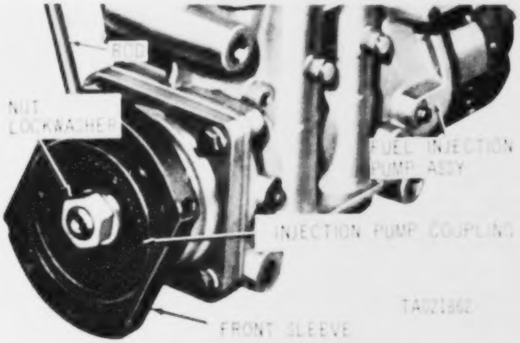


Figure 2-45. Removing or installing fuel injection pump coupling.

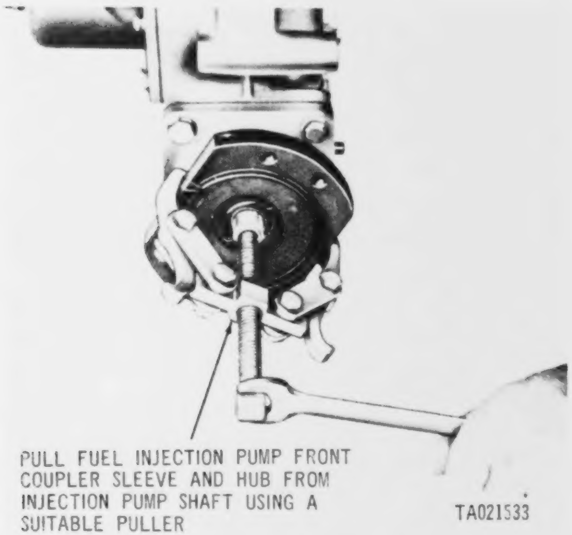

PULL FUEL INJECTION PUMP FRONT COUPLER SLEEVE AND HUB FROM INJECTION PUMP SHAFT USING A SUITABLE PULLER

Figure 2-46. Removing fuel injection pump coupling sleeve and hub.

b. Installation

(1) Install woodruff key and injection pump coupling half on pump shaft and secure with lockwasher and plain nut (fig. 2-45). Position a metal rod in one of the sleeve alinement holes and torque tighten plain nut to 900 pound-inches. Install new preformed packing in groove in face of coupling sleeve. Use a light coating of grease to hold performed packing in position.

(2) Remove timing hole plug (fig. 2-47). Turn injection pump shaft with drive coupling until marked gear tooth is visible (fig. 2-48).

NOTE

It is possible to have the timing mark on the coupling alined with mark on the injection pump bearing retaining plate (fig. 2-49) and not have the marked gear tooth visible in timing hole. Make sure marked tooth (fig. 2-48) is visible when timing marks are alined. If the marked tooth is not visible, rotate the pump shaft 360° in either direction. Aline the coupling timing marks and the marked tooth will be visible in the timing hole. Install timing hole plug.

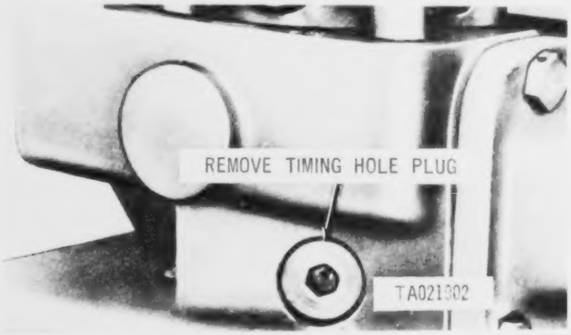

REMOVE TIMING HOLE PLUG

Figure 2-47. Removing or installing fuel injection pump timing hole plug.

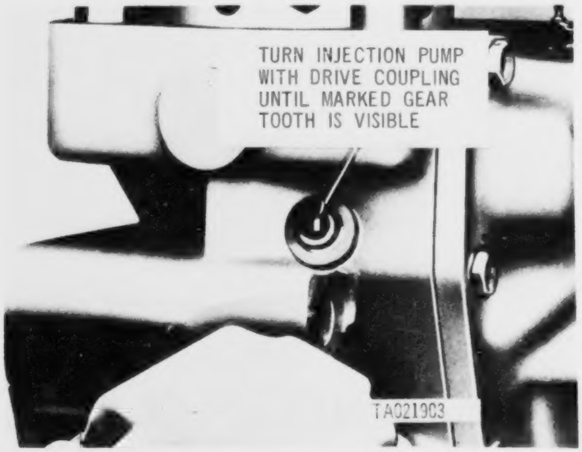

TURN INJECTION PUMP WITH DRIVE COUPLING UNTIL MARKED GEAR TOOTH IS VISIBLE

Figure 2-48. Fuel injection pump timing hole showing marked gear tooth.

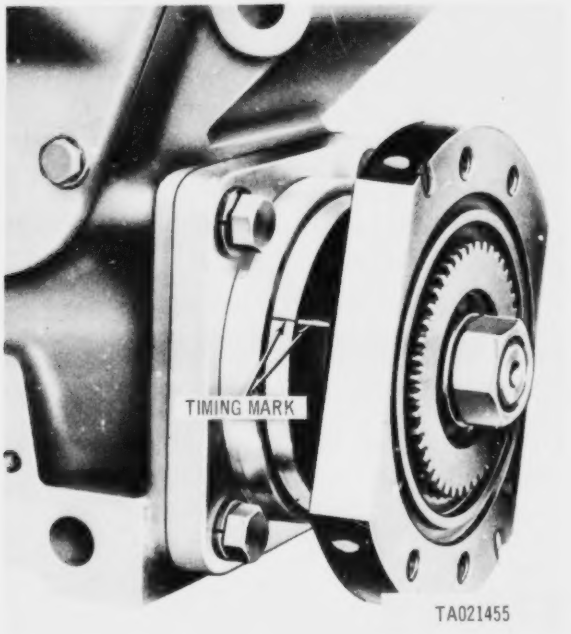


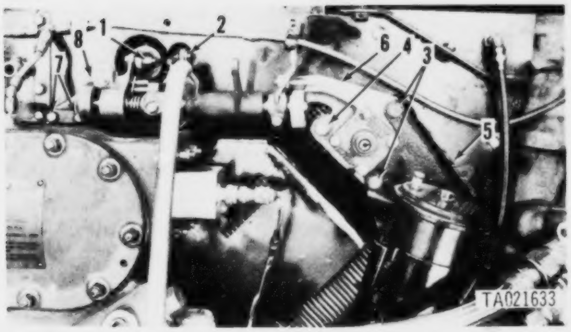
Figure 2-49. Timing marks on fuel injection pump bearing retaining plate and coupling hub alined.

NOTE

Before the fuel injection pump is installed on the engine, the engine must be properly timed with number one right bank cylinder on the compression stroke. In order to set engine timing, it is necessary to remove the primary fuel filter bracket and throttle linkage to check position of camshaft lobes (fig. 2-52).

(3) Remove self-locking nut and machine bolt (1, fig. 2-50) and disconnect rod from injection pump lever. Remove cotter pin and flat washer (2) and disconnect rod from manual fuel shut-off lever. Discard cotter pin. Remove two capscrews and lockwashers (3) and one capscrew and lockwasher (4) attaching primary fuel filter bracket (5) and throttle linkage plate (6) to number 1R cylinder assembly. Move primary fuel filter and bracket to one side with inlet and outlet hoses attached. Remove two capscrews and lockwashers (7) attaching throttle cross shaft bracket (8) to crankshaft damper and oil filter housing. Remove end plate, and throttle linkage as an assembly. Remove and discard gasket.

(4) Turn flywheel (fig. 2-51), using splined wrench, Part No. 10882747. Aline 1R INJ PORT CLOSE timing mark on flywheel with timing pointer.



1 Self-locking nut and machine bolt
2 Cotter pin and flat washer
3 Capscrew and lockwasher
4 Capscrew and lockwasher
5 Primary fuel filter bracket
6 Throttle linkage plate
7 Capscrew and lockwasher
8 Throttle cross shaft bracket

Figure 2-50. Removing or installing primary fuel filter bracket and throttle linkage.

CAUTION

Be sure pointer alines with correct timing mark on flywheel (fig. 2-51).

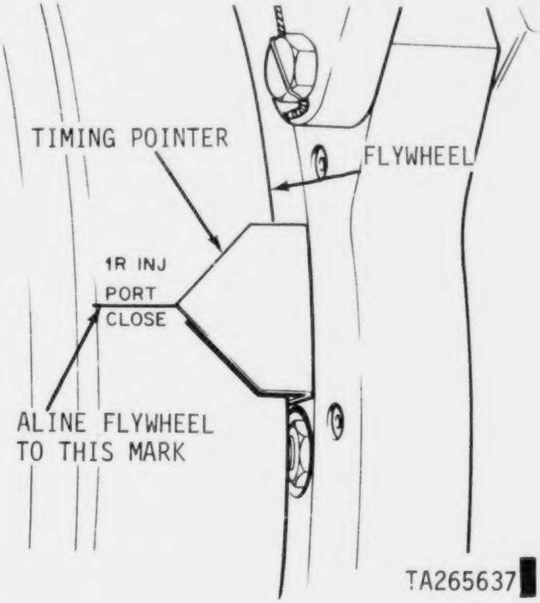


Figure 2-51. Flywheel in position for fuel injection pump timing, model AVDS-1790-2C and AVDS-1790-2D engines.

(4.1) Turn crankshaft (fig. 2-42.1), using improvised turning tool, until flywheel timing mark 1R INJ PORT CLOSE is alined with timing mark on the transmission housing adapter, figure 2-51.1.

CAUTION

Be sure the correct timing marks are alined.

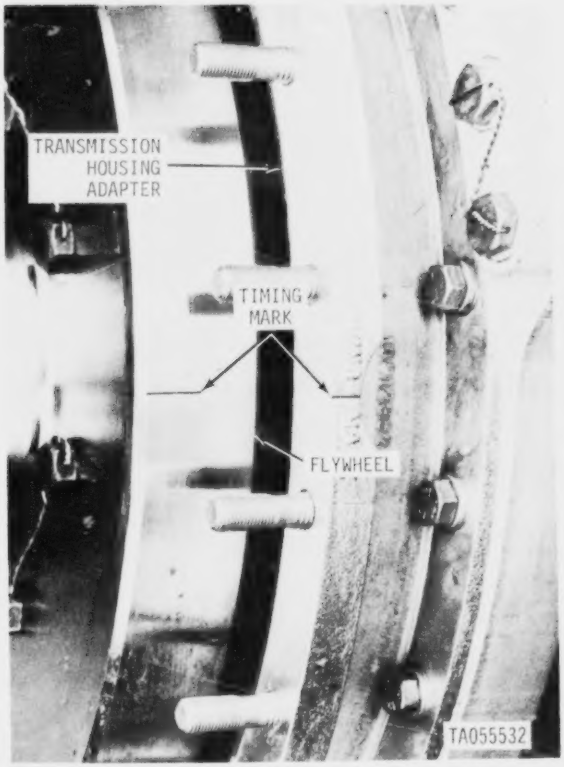

TRANSMISSION HOUSING ADAPTER
TIMING MARK
FLYWHEEL
TA055532

Figure 2-51.1. Flywheel in position for fuel injection pump timing, model AVDS-1790-2DR engine.

NOTE

Camshaft lobes must be in position shown in figure 2-52 for proper injection pump timing. If not, rotate flywheel 360 degrees to aline timing marks and properly position camshaft lobes.

(5) Push drive coupling sleeve (fig. 2-53) toward rear fan and accessory drive housing, until sleeve clears splined hub. Rotate coupling sleeve until identification marks approximate the correct position to mate with injection pump drive coupling sleeve identification marks.

(6) Install new preformed packing on fuel injection pump mounting base oil transfer tube, and install lower rear bolt and plain washer (fig. 2-44) in pump housing.

NOTE

Be sure fuel injection pump lower right mounting bolt is inserted in injection pump before pump is seated on mounting base. The bolt cannot be installed with pump in position.

(7) Position pump with mounting bolts on mounting base and install three bolts and plain washers (fig. 2-44). Torque tighten the four bolts to 600 pound-inches and install locking wire.

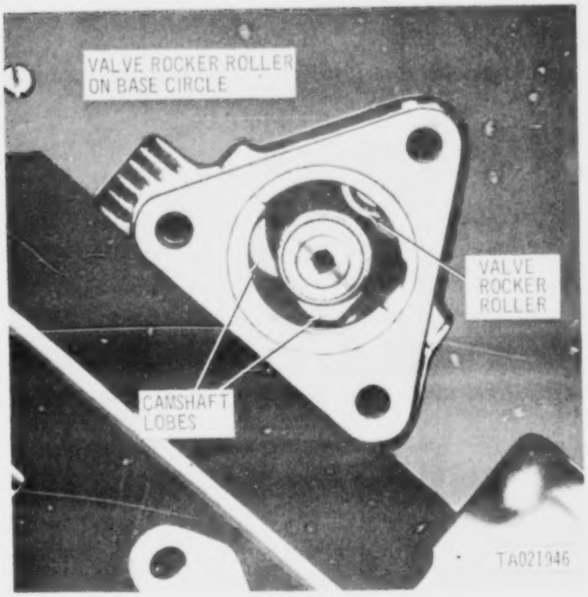

VALVE ROCKER ROLLER ON BASE CIRCLE
VALVE ROCKER ROLLER
CAMSHAFT LOBES
TA021946

Figure 2-52. Correct position of camshaft lobes on 1R cylinder for injection pump timing.

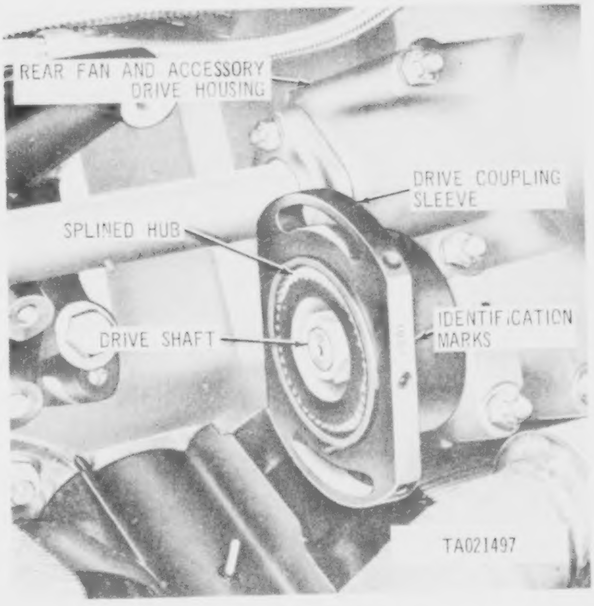

REAR FAN AND ACCESSORY DRIVE HOUSING
DRIVE COUPLING SLEEVE
SPLINED HUB
IDENTIFICATION MARKS
DRIVE SHAFT
TA021497

Figure 2-53. Correct position of fuel injection pump drive coupling on hub before pump installation.

NOTE

Be sure preformed packing is installed in coupling sleeve.

(8) Install throttle control rod (7, fig. 2-41) and secure to lever with machine bolt, washer and self-locking nut. Install spring angle bracket (5, fig. 2-41) on injector pump and secure with two

capscrews and lockwashers (4). Connect spring (3) to injection pump lever and to angle bracket. Install manual fuel shutoff rod (2) and secure to injection pump lever with flat washers and cotter pin (1).

(8.1) Install angle bracket (5, fig. 2-41.1) on fuel injection pump and secure with three lockwashers and capscrews (4). Connect throttle control rod assembly (7) to pump lever and secure with machine bolt, flat washer and self-locking nut (6). Attach the front end of the throttle control rod assembly (7) to the intermediate throttle lever and secure with machine bolt, flat washer and self-locking nut (8). Attach the manual fuel shut-off rod assembly (2) to the shut-off lever and secure with flat washer and cotter pin (1). Install manual fuel shut-off lever return spring (3).

(9) Position fuel injection pump coupling sleeves making sure timing marks on bearing retaining plate and coupling hub remain alined. These marks must be alined before attempting to assemble the coupling. Loosely position four lock plates, lockwashers, and machine bolts (fig. 2-43) in drive shaft coupling sleeves. Position two 5/16-in. steel rods (fig. 2-54), in sleeve alinement holes. Hold fuel injection pump drive coupling sleeve (nearest the pump) stationary and rotate the other drive coupling sleeve counterclockwise to remove backlash from the pump drive shaft. When backlash is removed, and flat sides of drive couplings are alined, tighten four drive coupling bolts securely. When flat sides of drive coupling sleeves (fig. 2-54) do not mate when backlash is removed, the coupling sleeves must be separated and reset. Separate coupling and push sleeve of drive shaft from hub splines. Adjust sleeve on splines so flat sides of coupling halves are alined. Torque tighten coupling bolts to 275 to 325 pound-inches. Remove two pipe plugs (fig. 2-54) from couplings.

(10) Install 1/16-27 lubrication fitting and lubricate coupling with MIL-G-81322 grease. Discontinue adding lubrication when grease shows in the hole on opposite side of coupling. Over filling cavity will result in failure of coupling seals. Remove lubrication fitting Install the pipe plugs (fig. 2-55).

(11) Install throttle cross shaft bracket (8, fig. 2-50), end plate (6) and throttle linkage using new gasket at 1R cylinder. Install one capscrew and lockwasher (4) securing end plate to the cylinder and two capscrews and lockwashers (7) securing throttle cross shaft bracket to damper housing. Position primary fuel filter and bracket (5) and install two capscrews and lockwashers (3). Position throttle control rod and lever and install self-locking nut and machine bolt (1). Position manual fuel shut-off rod and lever and install flat washer and cotter pin (2).

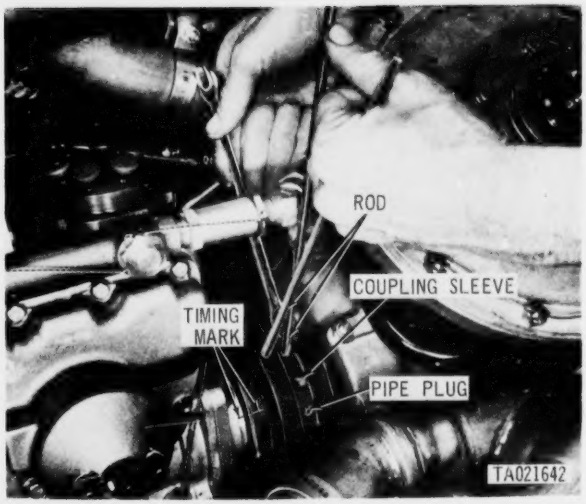


Figure 2-54. Removing fuel injection pump drive gear train backlash.

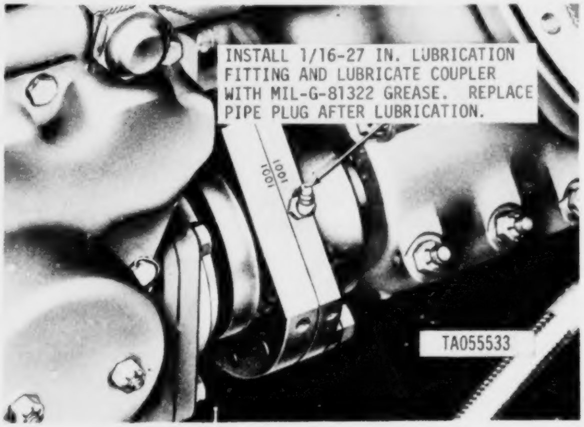

INSTALL 1/16-27 IN. LUBRICATION FITTING AND LUBRICATE COUPLER WITH MIL-G-81322 GREASE. REPLACE PIPE PLUG AFTER LUBRICATION.
1001
1001
TA055533

Figure 2-55. Fuel injection pump drive coupling with lubrication fitting installed.

(12) Check throttle control adjustable rod (fig. 2-56), manual fuel shut-off rod and throttle operating lever rod for free movement.

(13) Install check valve (6, fig. 2-40). Connect fuel return hose (5) to check valve (6), and fuel inlet hose (4) and oil inlet hose (3) to adapters. Connect electrical lead (2).

(14) With throttle linkage in full throttle position (A, fig. 2-57), clearance between lever stop pin and stop on bracket must be 3/16 inch minimum. With throttle linkage in idle position (B), clearance between lever stop pin and stop on bracket must be 3/16 inch minimum. When the foregoing clearances are not met, loosen lock nuts on adjustable rod (C), and adjust rod as necessary to obtain

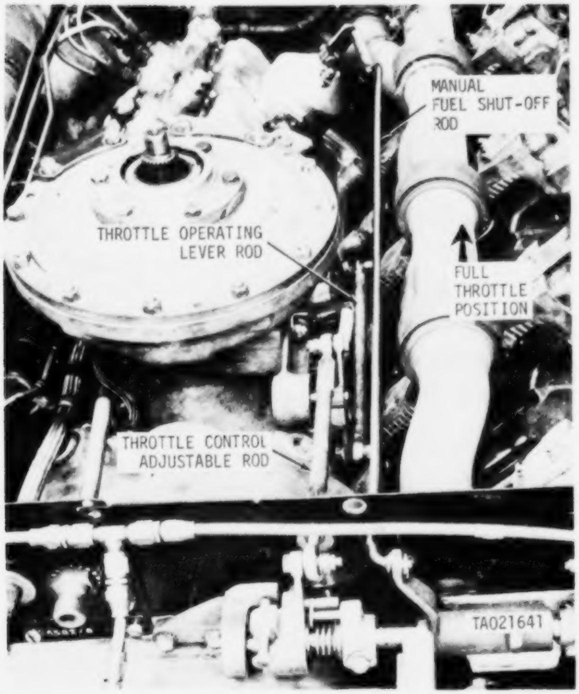


Figure 2-56. Checking throttle linkage for free movement.

required clearance. Tighten lock nuts after adjustment. The idle adjusting screw (D) must not be set until engine is installed and tested.

(14.1) With throttle linkage in full throttle position (A, fig. 2-57.1) clearance between lever stop pin and stop on bracket must be 1/8 to 3/16 inch minimum. With throttle linkage in idle position (B), clearance between lever stop pin and stop on bracket must be 3/16 inch minimum. When the foregoing clearances are not met, loosen lock nuts on adjustable rod (C), and adjust rod as necessary to obtain required clearance. Tighten lock nuts after adjustment. The idle adjusting screw (D) solenoid speed control screw (E) must not be set until engine is installed and tested.

CAUTION

Special precautions must be taken to ensure that all fuel injection pump tubes terminate at the proper cylinder (fig. 2-58). Incorrect hook-up of the injector tubes to a wrong cylinder or injection pump connection would result in damage to the piston rings and cylinder walls and severe damage to the engine if operated under full load. The hydraulic head outlet ports are numbered on the fuel injection pump. Overtightening will damage the tube ferrule and cause fuel leaks. Overtightening the support nut will damage fibre support sleeve and result in injector tube failure at this location.

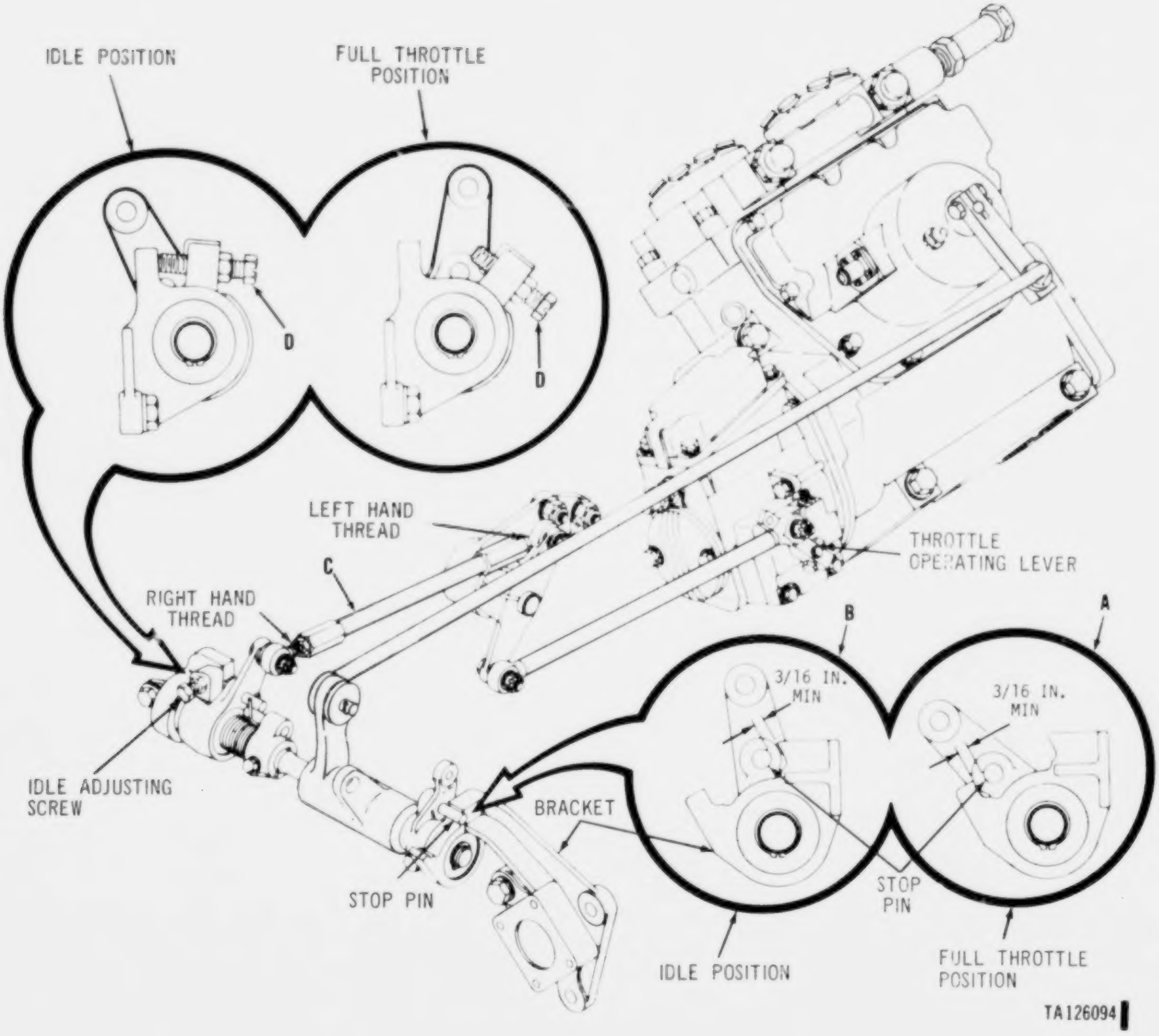

IDLE POSITION
FULL THROTTLE POSITION
D
D
LEFT HAND THREAD
C
THROTTLE OPERATING LEVER
RIGHT HAND THREAD
B
A
3/16 IN. MIN
3/16 IN. MIN
IDLE ADJUSTING SCREW
BRACKET
STOP PIN
STOP PIN
IDLE POSITION
FULL THROTTLE POSITION
TA126094

Figure 2-57. Throttle linkage adjustment, model AVDS-1790-2C and AVDS-1790-2D engines.

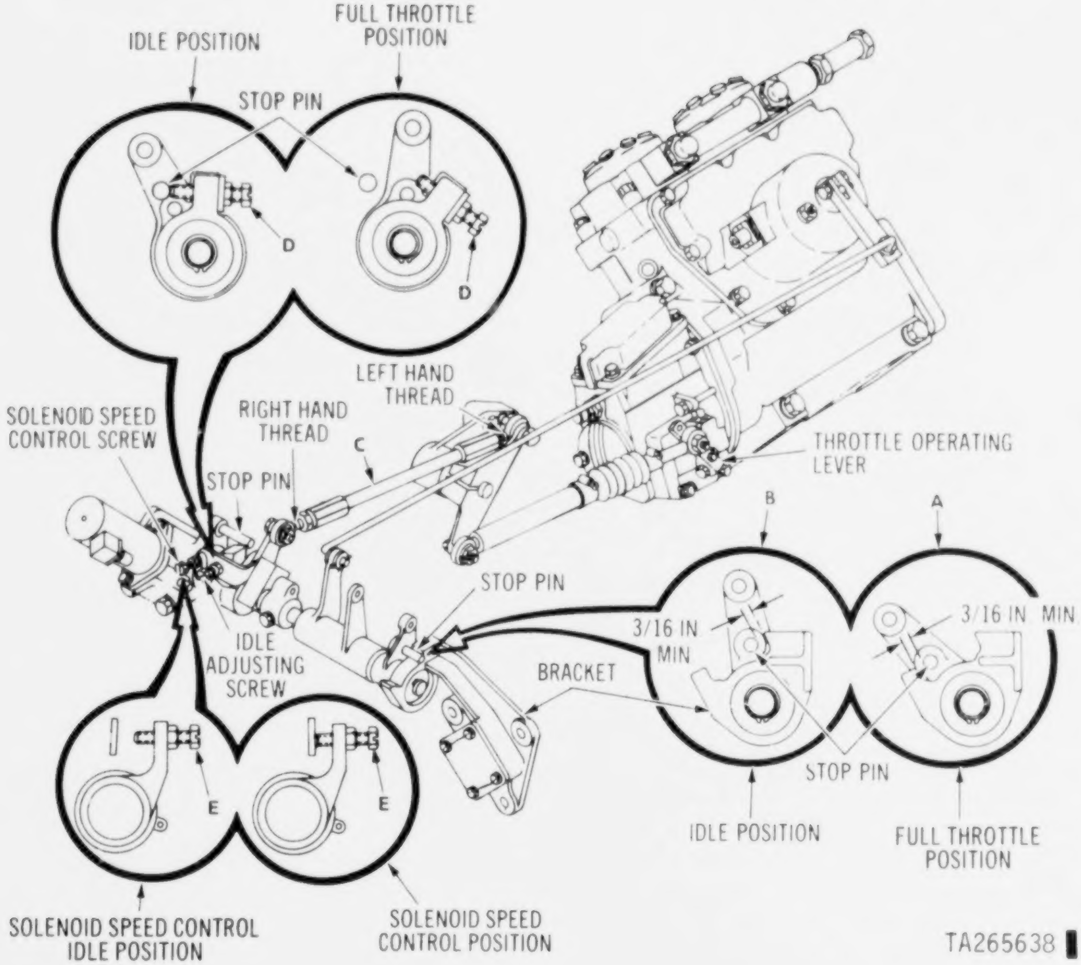

IDLE POSITION
FULL THROTTLE POSITION
STOP PIN
D
D
SOLENOID SPEED CONTROL SCREW
RIGHT HAND THREAD
LEFT HAND THREAD
C
STOP PIN
THROTTLE OPERATING LEVER
B
A
STOP PIN
3/16 IN MIN
3/16 IN MIN
IDLE ADJUSTING SCREW
BRACKET
STOP PIN
E
E
IDLE POSITION
FULL THROTTLE POSITION
SOLENOID SPEED CONTROL IDLE POSITION
SOLENOID SPEED CONTROL POSITION
TA265638

Figure 2-57.1 Throttle linkage adjustment, model AVDS-1790-2DR engine.

(15) Remove cap plugs (1, fig. 2-40) and individually connect the left bank injector tube connectors (fig. 2-39) to the rear injection pump hydraulic head (fig. 2-58). To assure adequate wrench clearance, connect tubes to rear pump head in the following order: 5, 3, 6, 2, 4 and 1. Start fittings on pump head and injector nozzle and holder assembly by hand until sleeve is seated. When sleeve is seated, an increase in torque will be evident. When this point is reached, torque tighten to 300 pound-inches. Tighten all fuel injector tube support nuts to 125 pound-inches. Individually install six fuel injector tubes from cylinder No. 1R through 6R to front hydraulic head (fig. 2-58). To assure adequate wrench clearance connect tubes to front pump head in the following order: 2, 4, 1, 6, 5 and 3. Secure tubes to pump head and injector nozzle and holder assemblies as outlined above.

(16) Position plates and clamps on fuel injector tubes and secure to fuel injector tube brackets (2, fig. 2-37) with 18 self-locking nuts and machine bolts (1).

(17) Position plates and clamps on fuel injector tubes as shown in figure 2-59 and install 11 self-locking nuts and bolts (3, fig. 2-37). Install two clamps and one plate on left rear clamp bracket and secure with two self-locking bolts (4, fig. 2-37). Floating clamps must be spaced as shown in figure 2-59 to minimize vibration.

(18) Position plates and clamps on fuel injector tubes at cylinder No. 1L through 6L and secure to clamp support (fig. 2-36) with twelve machine bolts and self-locking nuts. Install clamps

and supports at No. 1R through 6R cylinders in a similar manner.

CAUTION

Do not run engine above idle for longer than ten minutes without cooling fans.

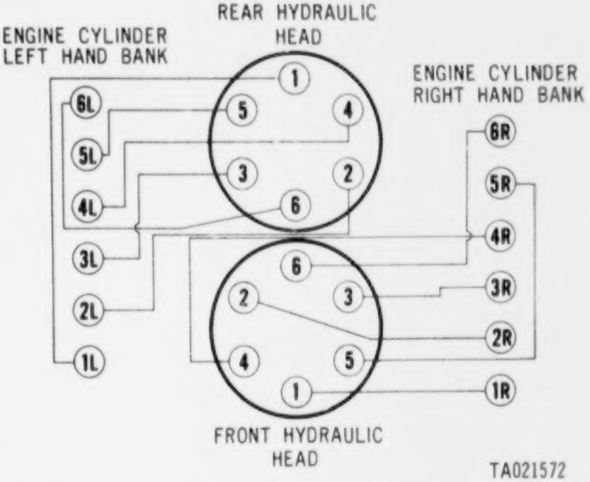

REAR HYDRAULIC HEAD
ENGINE CYLINDER LEFT HAND BANK
ENGINE CYLINDER RIGHT HAND BANK
6L
5L
4L
3L
2L
1L
1
5
4
3
2
6
6R
5R
4R
6
3
3R
2
2R
4
5
1
1R
FRONT HYDRAULIC HEAD
TA021572

Figure 2-58. Fuel injector tubes – schematic diagram.

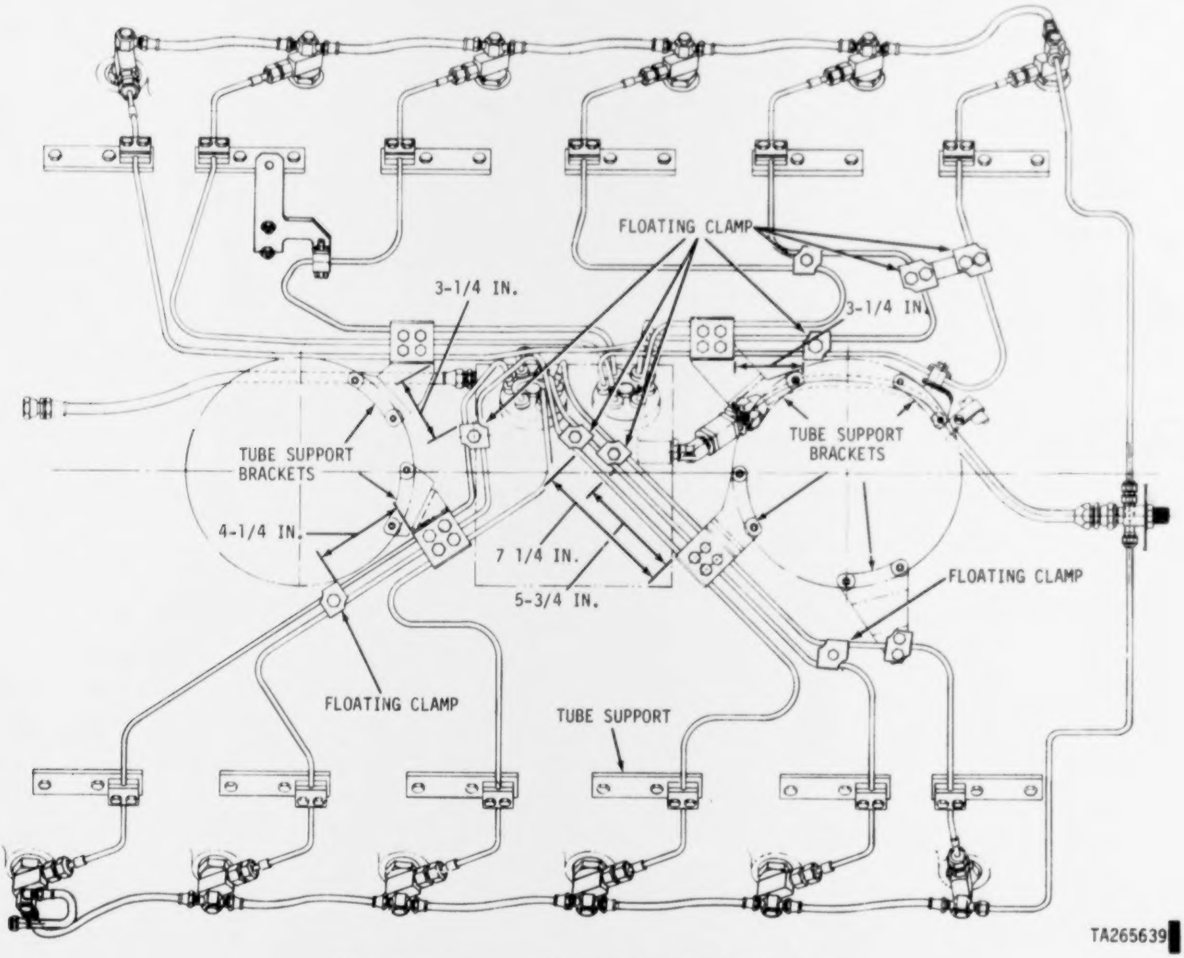

FLOATING CLAMP
3-1/4 IN.
3-1/4 IN.
TUBE SUPPORT BRACKETS
TUBE SUPPORT BRACKETS
4-1/4 IN.
7 1/4 IN.
5-3/4 IN.
FLOATING CLAMP
FLOATING CLAMP
TUBE SUPPORT
TA265639

Figure 2-59. Location of fuel injector tube floating clamps.

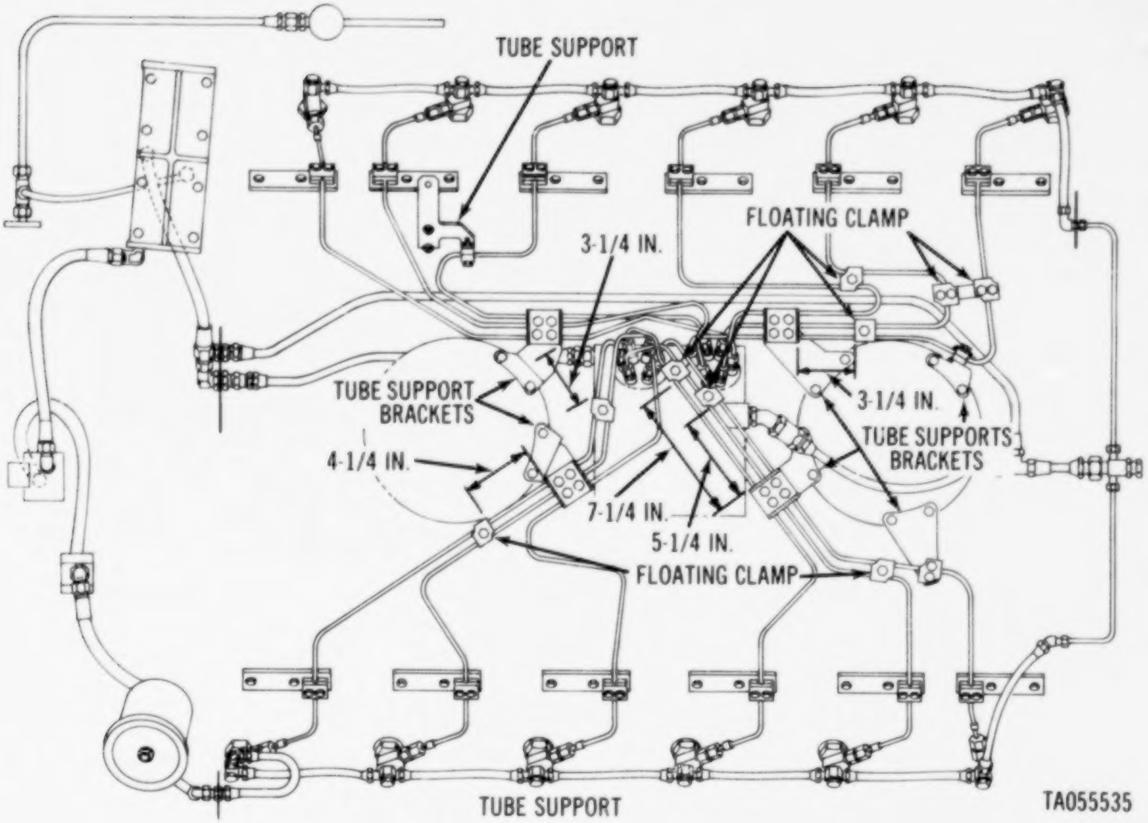


Figure 2-59.1. Location of fuel injector tube clamps, model AVDS-1790-2DR engine.

NOTE

The fuel injection pump, fuel tubes, and fuel tube connections must be checked for fuel leaks with the engine running before the cooling fans are installed.

(19) Install a fan rotor hub sleeve spacer, part No. 10882651 (fig. 2-60), on each fan drive vertical drive shaft to prevent oil seepage at fan drive oil seals while operating engine. Secure the spacer to each drive shaft with the nut used to secure the cooling fan. Start engine and check for fuel leaks. If leaks are evident, loosen the tube fittings and retighten. Replace fuel injection tubes if leak persists. Remove sleeve spacers.

(20) Position cooling fans shroud and fan housings (fig. 2-35) on engine. Be sure raised fan housing is to the rear of the engine. Install three assembled washer bolts (2), attaching left and right rear shroud and left and right rear center shroud to cooling fan shroud. Install four assembled washer bolts flat washers and hexagon nuts (1), attaching rear shroud and cylinder head fuel return tube clamps to cooling fan shroud.

(20.1) Position cooling fan shroud and fan housings (fig. 2-35) on engine. Be sure raised fan housing is toward rear of engine. Install three assembled washer bolts (2, fig. 2-35.1) attaching left and right rear shroud and left and right rear center shroud to cooling fan shroud. Install four assembled washer bolts (1) and self-locking nuts (not shown) securing the fuel return tube clamps and cooling fan shroud to the rear shrouds.

(21) Install five assembled washer bolts, and one hose clamp (fig. 2-34), attaching cooling fan shroud and oil cooler vent hose clamps to left and right shroud.

(22) Install front and rear upper covers to both left and right bank oil cooler supports.

(a) Position right rear upper cover (10, fig. 2-33) first, and right front upper cover (11, fig. 2-33). Secure oil sampling inlet hoses using four assembled washer bolts and loop clamps (5, fig. 2-31).

(b) Attach oil sampling valve bracket (4) using two assembled washer bolts (3).

(c) Attach wiring cable harness bracket (2) to front right upper cover using four assembled

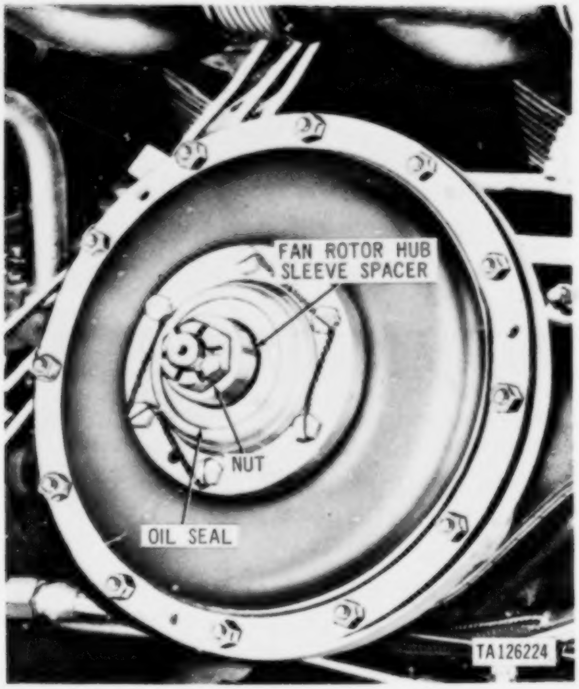


Figure 2-60. Fan drive housing fan rotor hub sleeve spacer installed for leakage test.

washer bolts (1). Secure cable harness to top of side cable bracket with retaining strap (7) and two capscrews and lockwashers (6).

(d) Install right rear upper cover first, then right front upper cover, secure with twelve assembled washer bolts.

(e) Install two new preformed packings on tube cap neck attached to left front upper cover. Position first left rear upper cover and then left front upper cover as shown in figure 2-33.

(f) Attach smoke generating fuel line to upper covers using three assembled washer bolts to secure three loop clamps (4, fig. 2-31.1) to left upper cover.

(g) Position wiring harness cable bracket and secure cable to top of side bracket with loop clamp (8), retaining strap (7) and two capscrews and lockwashers (6).

(h) On early engines, secure cable bracket to front upper cover using four capscrews and lockwashers (fig. 2-32). On late engines, secure harness cable bracket (3, fig. 2-31.1) using two socket head capscrews (1), three assembled washer bolts (2) and one loop clamp. Install remaining two loop clamps and assembled washer bolts (5) securing the smoke generating system electrical lead.

(i) Secure left front and rear upper covers using twelve remaining assembled washer bolts. Install oil gage indicator rod and close oil indicator tube cap.

(j) Install 12 self-locking nuts and flat washers (4, fig. 2-33) and two assembled washer bolts (right side) attaching cooling fan shroud to top frame.

NOTE

Model AVDS-1790-2DR is not equipped with wiring harnesses.

(22.1) On Model AVDS-1790-2DR install front and rear upper covers to both left and right bank oil cooler supports; the front covers overlap the rear covers.

(a) Install right rear upper cover (12, fig. 2-33.1) and secure with 10 assembled washer bolts (11). Install right front upper cover (14) and secure with 12 assembled washer bolts (13).

(b) Install left bank cover adapter (10) and secure with five assembled washer bolts (9).

(c) Install left rear upper cover (8) and secure with eight assembled washer bolts (fig. 2-33.1).

(d) Install two new preformed packings on the oil level indicator tube cap neck and install the left front cover assembly (7). Secure cover with eight assembled washer bolts (6). Install oil gage indicator rod and close oil indicator tube cap.

(e) Install retaining strap (5) and secure with two assembled washer bolts (4).

(f) Install four assembled washer bolts (3, fig. 2-33.1) and 12 self-locking nuts and flat washers (2).

(23) Position front cooling fan and hub assembly (2, fig. 2-33) on vertical drive shaft. Install flat washer and slotted nut (1). Torque tighten slotted nut to 600 lb in. and secure with new cotter pin. Install rear cooling fan and hub assembly (3) in the same manner.

(24) With cooling fan shroud and fan housing installed, check clearance between end of each cooling fan blade and rim of cooling fan housing with feeler gage (fig. 2-61). Clearance must be 0.062 inch minimum. When clearance is not within limits, loosen screws (fig. 2-61) and shift housing as necessary until clearance is obtained.

(25) Position cooling fan vane (6, fig. 2-30) on rear fan housing (7) and install two capscrews and lockwashers (5), and install two bolts and lockwashers (4). Position cooling vane (6) on front fan housing (3) and install two capscrews and lockwashers (2), and two bolts and lockwashers (1).

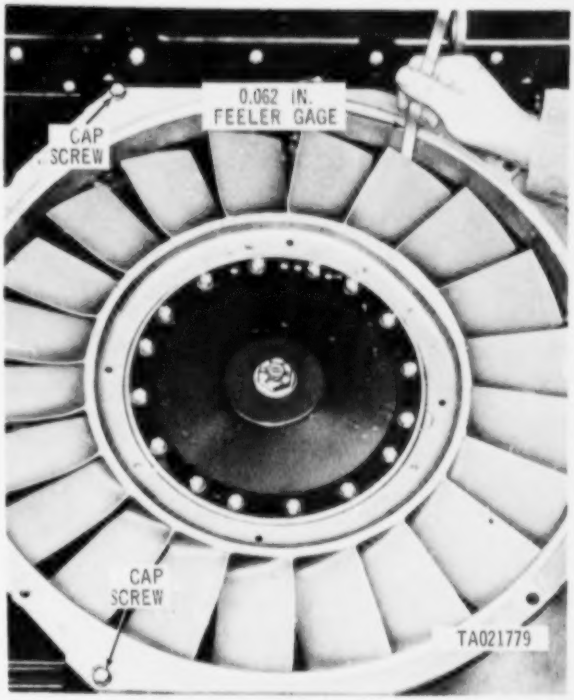


Figure 2-61. Checking cooling fan blade clearance.

Section V. REPLACEMENT OF ENGINE COMPONENTS

2-22. General

a. This section covers the instructions for the replacement of individual engine components. Removal procedures for components are provided. However, if a procedure is the same as provided for in the replacement of another component, reference is made to that paragraph rather than repeated.

b. Certain components, e.g. oil filters and fuel filters, are serviced at periodic intervals. Refer to the pertinent vehicle maintenance manuals. Most other components are serviced as a result of malfunctions determined while troubleshooting the engine.

c. All parts that are removed must be cleaned and inspected before being installed.

2-23. Fuel/Water Separator Filter

a. Removal.

(1) Open drain cock (fig. 2-62), and bleeder valve (1, fig. 2-64) and drain fuel into a suitable container.

(2) Disconnect fuel outlet hoses (1, fig. 2-63), and remove and retain fuel outlet tee (2) for installation in replacement filter. Disconnect fuel inlet hose (3). Remove and retain fuel inlet elbow. Disconnect fuel drain hose (5), remove and retain fuel drain elbow (6).

(3) Loosen, but do not remove, two lower capscrews (2, fig. 2-64). Remove two upper capscrews (3) and pull fuel/water separator away from bracket. Disconnect two water level probes (4). Remove the two lower capscrews, lockwashers, one flat washer and cushioned clamp (5) and remove fuel/water separator filter from mounting bracket (6). Remove and retain bleeder valve (1) for installation in replacement filter.

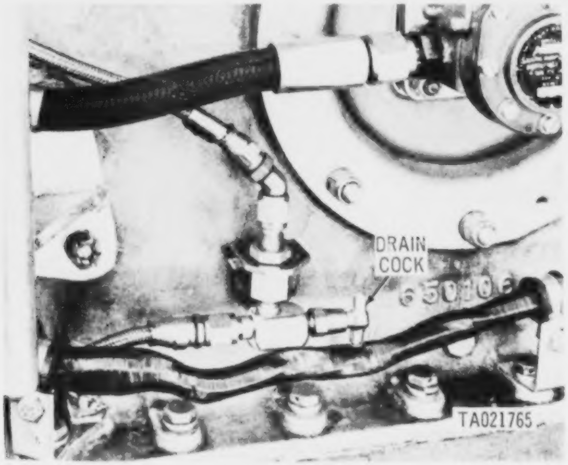
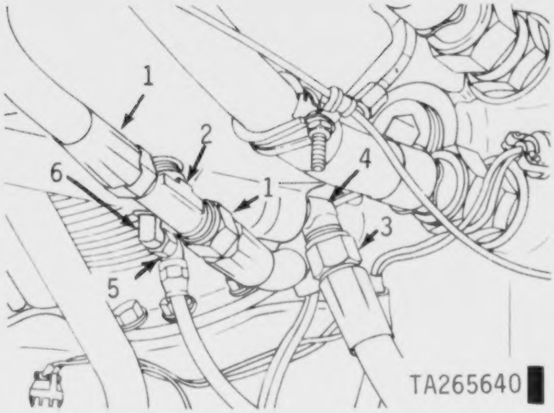


Figure 2-62. Fuel/water separator drain cock.

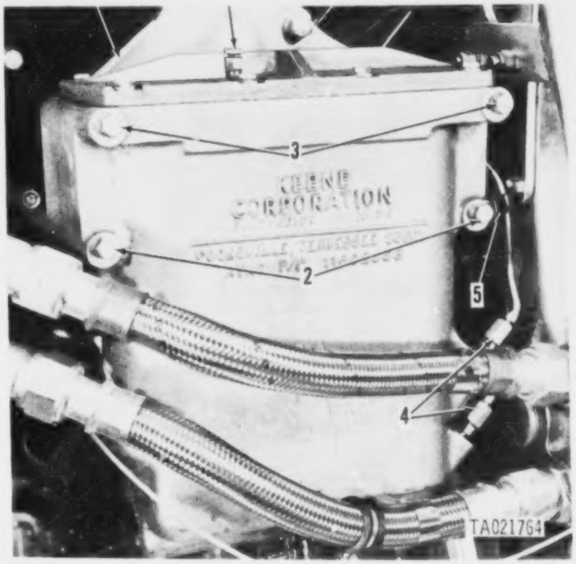
b. Installation.

(1) Install fuel/water separator filter on mounting bracket (6, fig. 2-64) and secure with two upper capscrews, lockwashers and flat washers (3). Do not tighten capscrews. Install two water level probes (4) and tighten capscrews (3). Attach cushioned clamp (5) to water level probe leads and install two lower capscrews, lockwashers, one flat washer (2) and cushioned clamp.



1 Fuel outlet hoses
2 Fuel outlet tee
3 Fuel inlet hose
4 Fuel inlet elbow
5 Fuel drain hose
6 Fuel drain elbow

Figure 2-63. Disconnecting or connecting fuel/water separator filter fuel and drain hoses.



1 Bleeder valve
2 Capscrew and lockwasher
3 Capscrew and lockwasher
4 Water level probe
5 Cushioned clamp
6 Mounting bracket

Figure 2-64. Removing or installing fuel/water separator filter.

NOTE

The water level probe that is connected to the lead from the upper connection of the control unit is identified by a band of red shrink tube and must be installed in the upper location of the filter.

(2) Install fuel drain elbow (6, fig. 2-63). Connect fuel drain hose (5). Install fuel inlet elbow (4) and connect fuel hose (3). Install fuel outlet tee

(2) and connect fuel outlet hoses (1). Remove shipping plug from filter cover and install bleeder valve (1, fig. 2-64) and open. Close drain cock (fig. 2-62) and purge fuel system. Close bleeder valve after purging.

2-24. Fuel/Water Separator Filter Elements

NOTE

Entire area around the fuel/water separator filter should be thoroughly cleaned to prevent the entry of dirt or other foreign objects before removing the cover.

a. Removal.

(1) Open drain cock (fig. 2-62) and bleeder valve (1, fig. 2-64) and drain fuel into a suitable container.

(2) Remove eight capscrews, lockwashers and plain washers (fig. 2-65).

(3) Remove cover (fig. 2-66) and remove and discard preformed packing. Remove and discard outer two coalescer elements from filter body.

NOTE

Do not remove the final (center) element (fig. 2-66) unless dirty or contaminated fuel make it necessary. Element removal could permit possible dirt entry into the fuel injection pump. This center element is normally serviced at engine overhaul only.

b. Installation.

(1) Install two new outer coalescer elements (fig. 2-66) in filter body, and a new preformed packing on body cover. Install cover and secure with eight capscrews, lockwashers and plain washers (fig. 2-65).

NOTE

Replacement elements and preformed packing are available in parts kit 5702738.

(2) Close drain cock (fig. 2-62), and purge fuel system. Close bleeder (1, fig. 2-64) valve after purging.

2-25. Primary Fuel Filter

a. Removal.

(1) Disconnect bleeder hose elbow (1, fig. 2-67) from connector (2). Open bleeder valve (3) and drain fuel into a suitable container. Remove bleeder hose connector and retain for installation in replacement filter.

(2) Disconnect fuel outlet hose (4). Remove and retain fuel outlet elbow (5). Loosen two self-locking nuts (6) and remove primary fuel filter (7) from primary fuel filter mounting bracket (8).

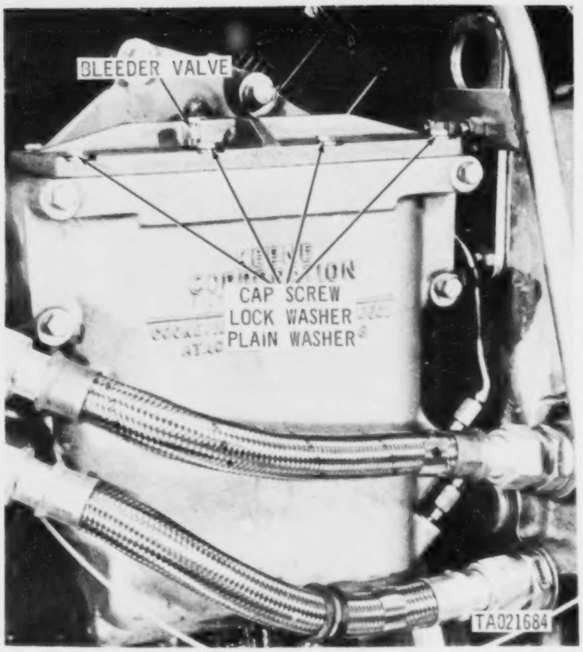


Figure 2-65. Removing or installing fuel/water separator filter cover.

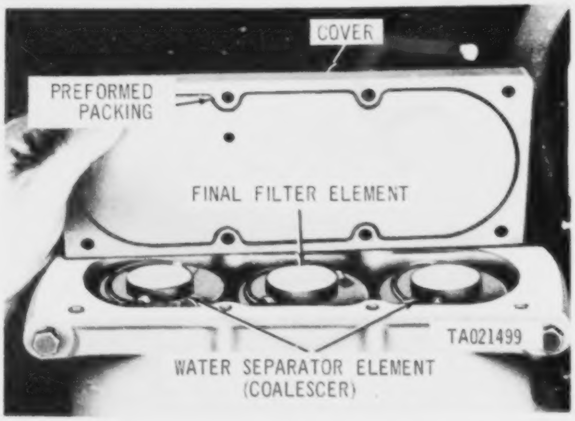
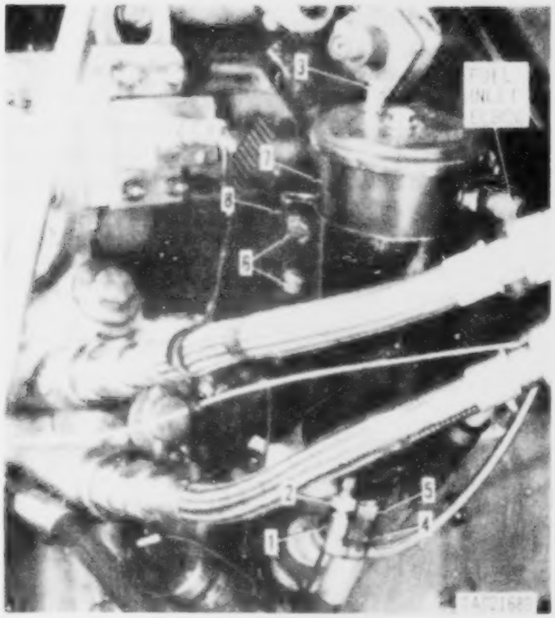


Figure 2-66. Removing and installing fuel/water separator filter elements.

b. Installation.

NOTE

The fuel inlet connection must be in the position shown in figure 2-67 for the Model AVDS-1790-2C engine, as shown in figure 2-68 for the Model AVDS-1790-2D, and as shown in figure 2-68.1 for the Model AVDS-1790-2DR engine.



1 Bleeder hose elbow
2 Connector
3 Bleeder valve
4 Fuel outlet hose
5 Fuel outlet elbow
6 Self-locking nut
7 Primary fuel filter
8 Mounting bracket

Figure 2-67. Removing or installing primary fuel filter, model AVDS-1790-2C engine.

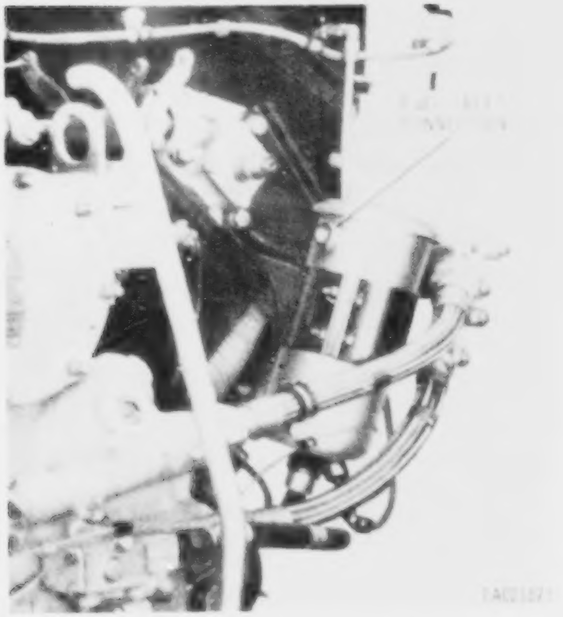


Figure 2-68. Installed primary fuel filter, model AVDS-1790-2D engine.

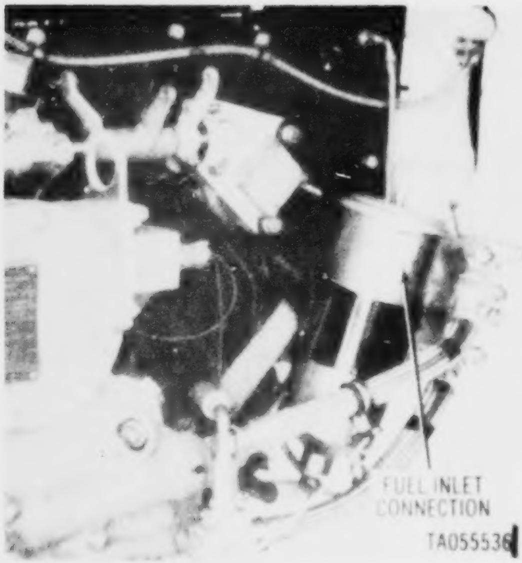


Figure 2-68.1. Installed primary fuel filter, model AVDS-1790-2DR engine.

(1) Clean orifice in hose connector (2, fig. 2-67) and install connector and fuel outlet elbow (5) in filter. Install primary fuel filter (7) in mounting bracket (8) and tighten two self-locking nuts (6).

(2) Connect bleeder hose elbow (1) to connector and fuel outlet hose (4) to elbow.

(3) Purge fuel system. Close bleeder valve (3) after purging.

2-26. Primary Fuel Filter Element

a. Removal.

(1) Disconnect bleeder hose elbow (1, fig. 2-67) from connector (2). Open bleeder valve (3) and drain fuel into a suitable container.

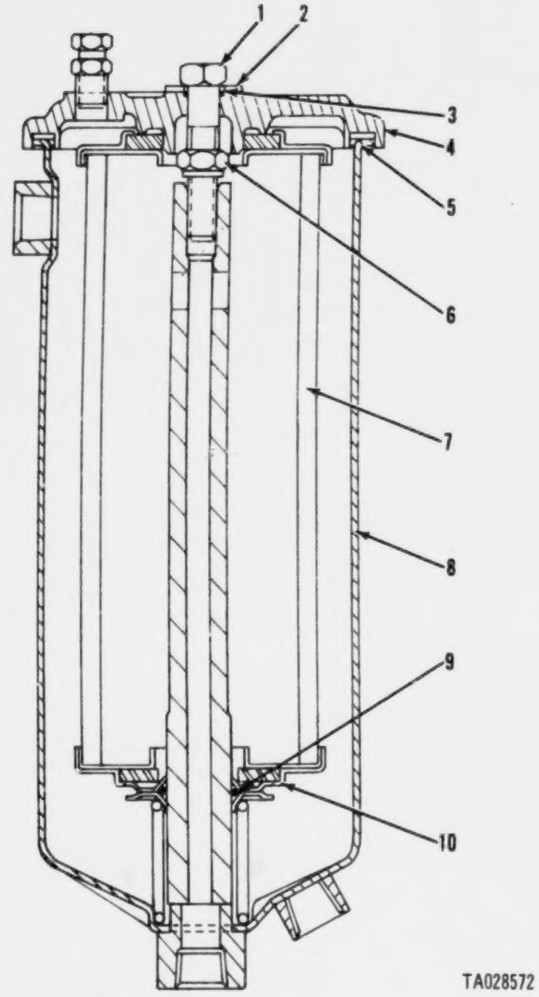
(2) Loosen retaining screw (1, fig. 2-69) and remove head (4) from body assembly (8). Remove and discard gasket (5). Remove and retain lock nut (6) and screw (1). Remove and discard gasket (3) and washer (2).

(3) Remove and discard element (7). Remove retainer assembly (10) from body and remove and discard preformed packing (9).

b. Installation.

(1) Install a new preformed packing (9, fig. 2-69) in the retainer assembly (10) and install retainer in body assembly (8). Install new element (7).

(2) Position a new gasket (3) and washer (2) on the head (4) and install retaining screw (1) and secure with lock nut (6). Install a new gasket (5) and install head assembly to body assembly and secure by tightening retaining screw.



1 Retaining screw
2 Washer
3 Gasket
4 Head
5 Gasket
6 Nut
7 Element
8 Body assembly
9 Preformed packing
10 Retainer assembly

Figure 2-69. Removing or installing primary fuel filter element.

NOTE

Replacement element, gaskets, preformed packing and washer are available in parts kit 5704487.

(3) Connect bleeder hose elbow (1, fig. 2-67). Purge fuel system. Close bleed valve (3) after purging.

2-26.1. Fuel Injection Pump Final Filter

a. Removal.

(1) Remove the front cooling fan vane cooling fan, refer to paragraph 2-21*a*.

(2) Clean the area around the fuel injection pump and fuel inlet hose to preclude the entrance of foreign material into the filter housing cavity.

(3) Disconnect the final filter inlet hose.

(4) Cut and remove locking wire from final filter retainer. Remove filter retainer (with adapter installed) using socket wrench, Part No. 12254213 (fig. 2-69.1). Remove and discard retainer preformed packing. Remove and discard filter.

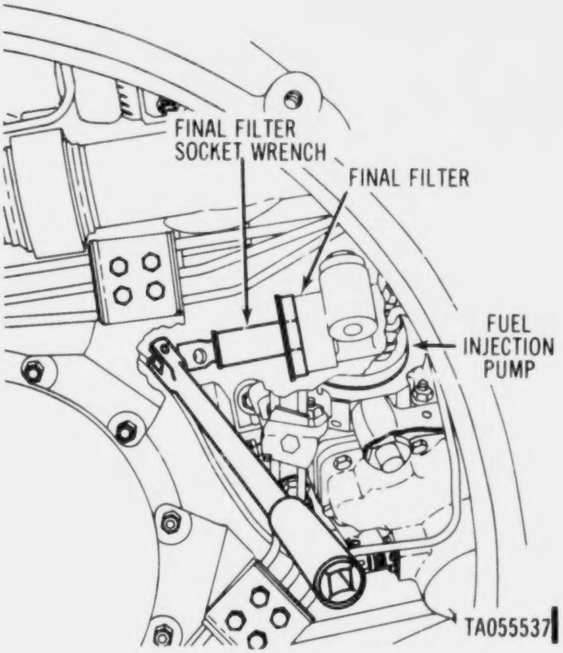


Figure 2-69.1. Removing final filter retainer using socket wrench.

CAUTION

Do not attempt to clean the filter cavity.

b. Installation.

NOTE

Replacement filter and preformed packing are available in parts kit 5702739 (NSN 2910-00-801-1154).

(1) Install new filter in housing with pilot end toward front of pump.

(2) Install new preformed packing on filter retainer and install retainer in housing. Torque tighten retainer to 25 to 30 pound-feet using socket wrench, Part No. 12254213. Secure retainer with locking wire.

(3) Connect final filter inlet hose.

(4) Install front cooling fan and cooling fan vane. Refer to paragraph 2-21*b*.

2-27. Oil Coolers

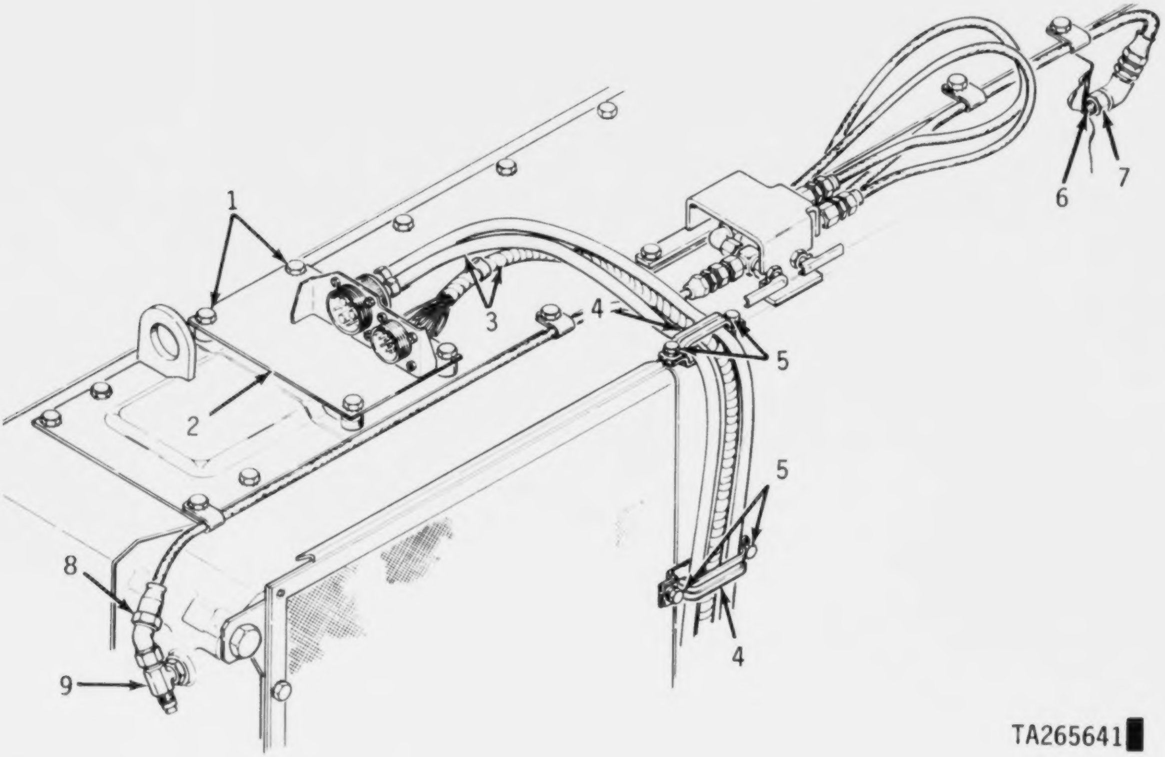
NOTE

The oil coolers on each side of the engine are removed in the same manner. For instructional purposes removal of the right coolers is described in the following instructions. Model AVDS-1790-2DR oil cooler removal and installation instructions are similar to those described below except that this engine is not equipped with an engine wiring harness, nor the oil sampling system shown in figure 2-70.

a. Removal.

(1) Remove four capscrews and lockwashers (5, fig. 2-70) and remove two retaining straps (4). Remove four assembled washer bolts (1) and wiring harness bracket (2) and wiring harness (3) as an assembly.

(1.1) Remove engine oil line coupling nut (8) from vent line tee (9). Remove transmission oil line coupling nut (7) from transmission oil cooler adapter (6). Remove adapter (6) and retain for installation in new oil cooler. Remove and discard preformed packing.



1 Assembled washer bolt
2 Wiring harness bracket
3 Wiring harness
4 Retaining strap
5 Capscrew and lockwasher
6 Adapter
7 Transmission oil line
8 Engine oil line
9 Tee

Figure 2-70. Removing or installing wiring harness, Model AVDS-1790-2C and AVDS-1790-2D engines.

(2) Remove four assembled washer bolts (fig. 2-71) and remove wiring harness bracket assembly and transmission oil cooler screen.

(3) Disconnect oil cooler inlet hose (1, fig. 2-72) and oil cooler outlet hose (2) and drain oil into a suitable container. Disconnect oil cooler vent hose elbow (3). Remove oil cooler vent hose tee (4) and retain for installation in replacement cooler. Remove and discard preformed packing (5).

(4) Remove four machine bolts (6) and remove engine oil cooler screen (7), damper end oil cooler screen bracket (8), center oil cooler screen bracket (9) and engine oil cooler (10) as an assembly from oil cooler support frame.

(5) Remove two machine bolts (11) and remove transmission oil cooler screen bracket (12). Remove two machine bolts and flat washers (13) and remove transmission oil cooler (14) from oil cooler support frame.

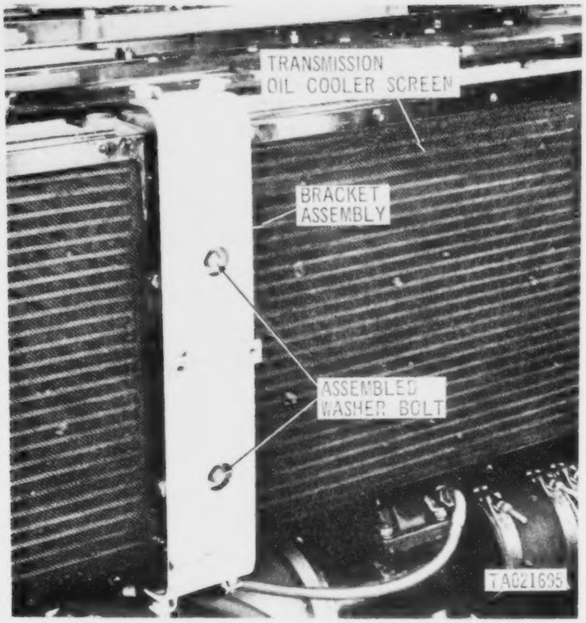
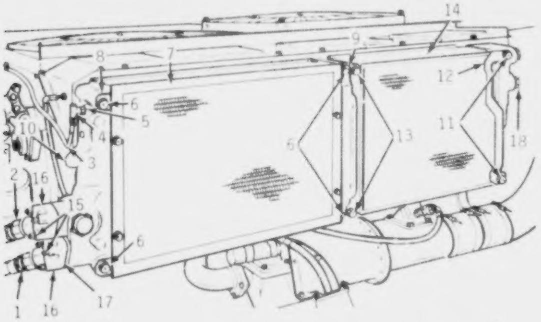


Figure 2-71. Disconnecting or connecting wiring harness assembly bracket.



1	Inlet hose
2	Outlet hose
3	Vent hose elbow
4	Vent hose tee
5	Preformed packing
6	Machine bolt
7	Engine oil cooler screen
8	Damper end oil cooler screen bracket
9	Center oil cooler screen bracket
10	Engine oil cooler
11	Machine bolt
12	Transmission oil cooler screen bracket
13	Bolt and washer
14	Transmission oil cooler
15	Self-locking nut, flat washer
16	Elbow connector
17	Gasket
18	Oil cooler thermostatic bypass valve

Figure 2-72. Removing or installing engine and transmission oil cooler.

(6) Remove six self locking nuts and flat washers (15) and remove two connector elbows (16). Remove and discard gaskets (17).

(7) Remove transmission oil cooler thermostatic bypass valve (18) and retain for installation in replacement oil cooler. Remove and discard thermostatic valve spacer ring (gasket).

NOTE

Remove the engine oil cooler bypass valve in a similar manner.

b. Installation.

(1) Install oil cooler thermostatic bypass valve (18, fig. 2-72) using a new spacer ring (gasket).

NOTE

Install engine oil cooler bypass valve in a similar manner.

NOTE

The left bank lower engine oil cooler elbow on Model AVDS-1790-2C and AVDS-1790-2D is shorter than the other three elbows. All of the elbows on the AVDS-1790-2DR are the same.

(2) Install connector elbows (16) using new gaskets (17) and secure with six self-locking nuts and flat washers (15).

(3) Position transmission oil cooler screen bracket (12) on transmission oil cooler (14) and secure bracket and cooler to support frame with two machine bolts (11). Secure transmission oil cooler with two machine bolts and flat washers (13).

(4) Position center oil cooler screen bracket (9), damper end oil cooler screen bracket (8), and engine oil cooler screen (7) on engine oil cooler (10). Install brackets, screen and cooler as an assembly to the support frame and secure with four machine bolts (6).

(5) Install oil cooler vent hose tee (4) using new preformed packing (5). Connect oil cooler vent hose elbow (3), oil cooler outlet hose (2) and oil cooler inlet hose (1).

(6) Install transmission oil cooler screen (fig. 2-71) and wiring harness bracket assembly and secure to center oil cooler screen bracket and to transmission oil cooler screen bracket with four assembled washer bolts.

(6.1) Install transmission cooler adapter (6, fig. 2-70) with new preformed packing. Install transmission oil line coupling nut (7) to adapter (6). Install engine oil line coupling nut (8) to vent line tee (9).

(7) Install assembled wiring harness cable (3, fig. 2-70) and bracket (2) and secure to right front upper cover with four assembled washer bolts (1). Install two retaining straps (4) and secure to wiring harness bracket assembly with four capscrews and lockwashers (5).

2-28. Cylinder Head Oil Drain Tubes and Intake Manifold Tubes

NOTE

Intake manifold tubes for cylinder 1, 2, 5, and 6 on each side of the engine can be replaced without removing the complete intake manifold. However, the cylinder drain manifold must be removed before any intake tube can be replaced. Intake manifold tubes for cylinder 3 and 4 on each side of the engine cannot be replaced unless the complete intake manifold system is removed from the engine. For instructional purposes replacement of intake manifold tube for cylinder 2R is described in this section. Tubes for cylinders 1R, 5R, 6R, 1L, 2L, 5L and 6L are replaced in the same manner.

a. Removal.

(1) Remove cooling fan vanes, cooling fans, engine upper covers and cooling fan shroud. Refer to paragraph 2-21*a*.

(2) Remove oil coolers. Refer to paragraph 2-27*a*.

(3) Remove five assembled washer bolts (fig. 2-73) and one self-locking nut and bolt and remove transmission upper shroud assembly.

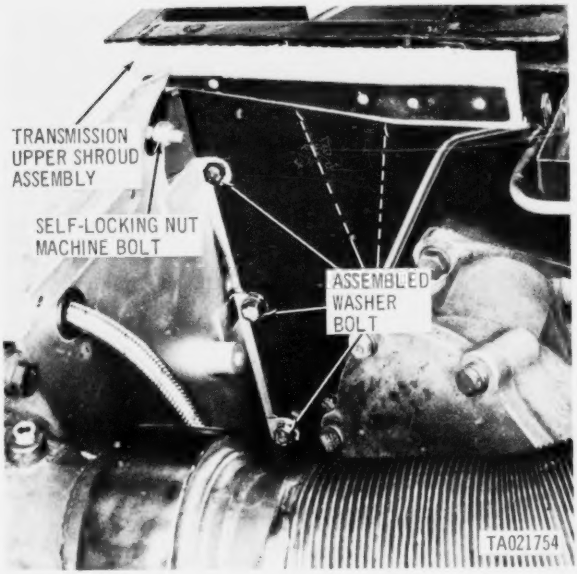


Figure 2-73. Disconnecting or connecting oil cooler support frame, model AVDS-1790-2C engine.

(3.1) Remove two hose clamps and preformed hose (fig. 2-73.1). Remove five assembled washer bolts to disconnect the shroud plate from the oil cooler support frame.

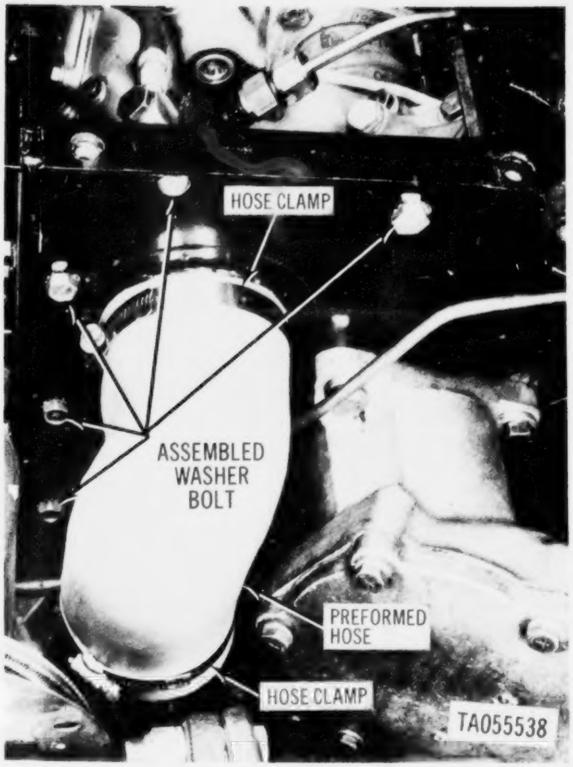


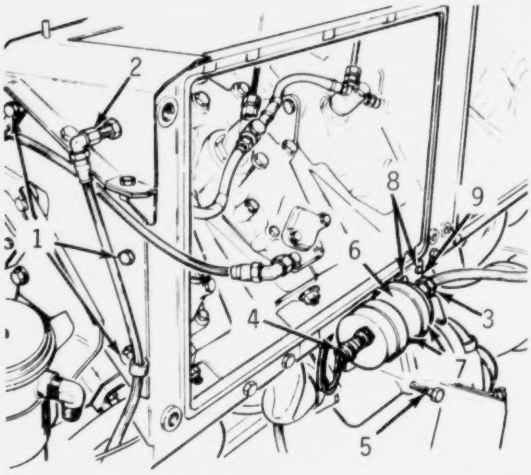
Figure 2-73.1. Connecting or disconnecting oil cooler support frame, model AVDS-1790-2D and AVDS-1790-2DR engines.

(4) Remove three assembled washer bolts (1, fig. 2-74) and disconnect primary fuel filter fuel drain elbow (2). Disconnect manifold heater spark plug electrical lead (3) and wiring harness (4). Remove two machine screws and self-locking nuts (5) and remove ignition unit (6) with clamps (7). Remove two machine screws and self-locking nuts (8) and disconnect wiring harness bracket (9).

(5) Disconnect fuel filter constant bleed hose (fig. 2-75) from bulk head union.

(6) Disconnect manifold air heater fuel inlet hose from elbow (1, fig. 2-76). Disconnect manifold air heater fuel return tube (2) and remove electrical lead (3). Remove six machine screws and self-locking nuts (4) and one screw and self-locking nut (5). Remove oil cooler support frame (6).

(7) Loosen four hose clamps (1, fig. 2-77). Remove machine screw and self-locking nut (2) attaching flame heater fuel inlet line cushioned clamp (3) to loop clamp. Cut locking wire (4) and remove two body bolts (5) intermediate drain tube (6) front drain tube (7) and hoses (8) as an assembly. Remove and discard four copper gaskets (9) (one under each bolt head and one between each drain tube and cylinder head).



1 Assembled washer bolt
2 Elbow
3 Electrical lead
4 Wiring harness
5 Machine screw and self-locking nut
6 Ignition unit
7 Clamp
8 Machine screw and self-locking nut
9 Bracket

Figure 2-74. Connecting or disconnecting oil cooler support frame.

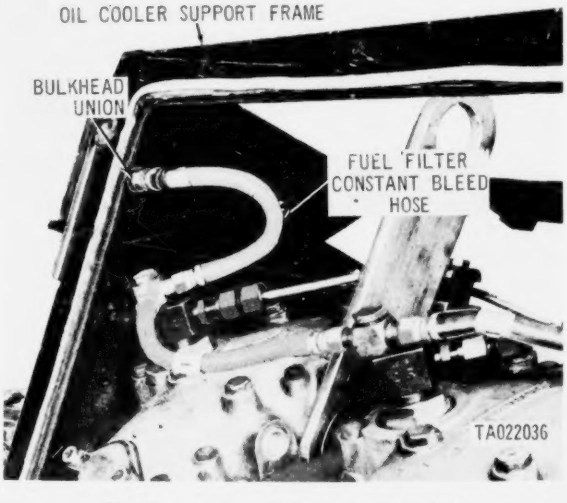
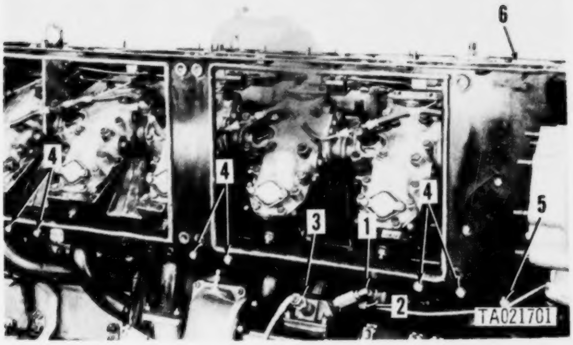


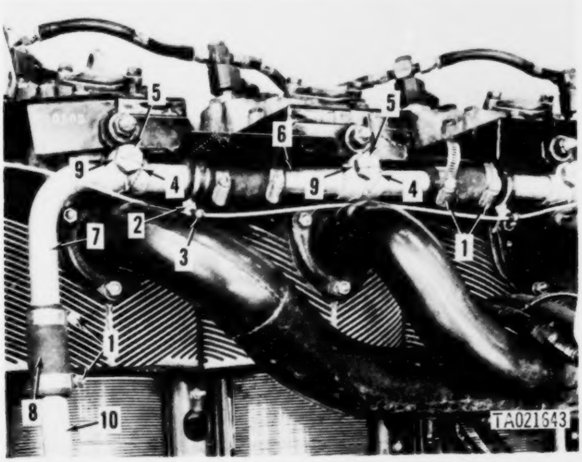
Figure 2-75. Removing or installing fuel filter constant bleed hose.

(8) Remove three plain nuts and lockwashers (1, fig. 2-78). Remove four self-locking nuts (2) and loosen manifold flange (3). Remove cylinder flange (4) from cylinder head studs and intake manifold tube (5) from intake manifold (6). Remove cylinder flange gasket (7) and intake manifold tube preformed packing, flat washer, spring washer, manifold flange (3) and cylinder flange (4), from intake



1 Elbow
2 Fuel return tube
3 Electrical lead
4 Machine screw and self-locking nut
5 Machine screw and self-locking nut
6 Oil cooler support frame

Figure 2-76. Removing or installing oil cooler support frame and baffle.



1 Hose clamp
2 Machine screw and self-locking nut
3 Cushioned clamp
4 Locking wire
5 Bolt
6 Intermediate oil drain tube
7 Front oil drain tube
8 Hose
9 Gasket
10 Oil drain tube

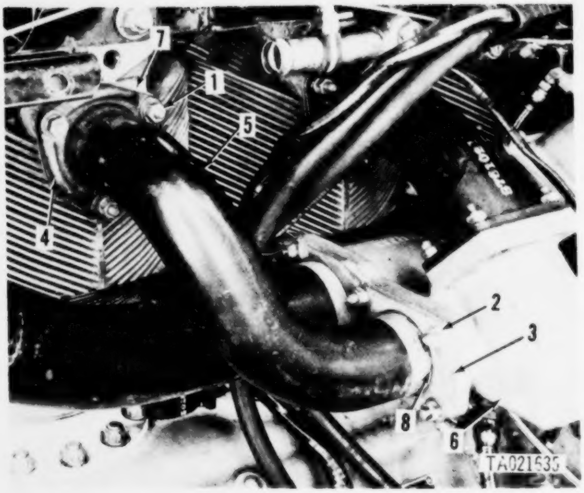
Figure 2-77. Removing and installing cylinder head oil drain tube.

manifold tube in order listed. Discard gasket and preformed packing.

b. Installation.

(1) Install cylinder flange (4, fig. 2-78), manifold flange (3), spring washer, flat washer and preformed packing (8, fig. 2-78) on intake manifold tube (5). Install a new gasket (7) on cylinder studs and install assembled intake manifold tube in intake manifold (6) and cylinder flange (4) on cylinder studs. Secure with four self-locking nuts (2) and three plain nuts and lockwashers (1).

(2) Install new solid copper gaskets (9, fig. 2-77) on body bolts (5) and insert bolts through drain tubes (6) and (7) and install new copper gasket (9) on body bolts (5). Secure assembled drain tubes and hoses (8) with body bolts and install locking wire (4). Slide hoses on oil drain tubes (10) and (11) and secure with four hose clamps (1). Install screw and nut (2) attaching flame heater fuel inlet line cushioned clamp (3) to loop clamp.



1 Nut and lockwasher
2 Self-locking nut
3 Manifold flange
4 Cylinder flange
5 Intake manifold tube
6 Intake manifold
7 Gasket
8 Preformed packing

Figure 2-78. Removing or installing cylinder No. 2R intake manifold tube.

(3) Install oil cooler support frame (6, fig. 2-76) and secure to oil cooler frame supports with six machine screws and self-locking nuts (4). Secure turbosupercharger support brace to frame with one machine screw and self-locking nut (5). Connect fuel inlet hose to manifold air heater fuel inlet elbow (1). Connect fuel return tube (2) and connect electrical lead (3).

(4) Connect fuel filter constant bleed hose (fig. 2-75) to bulkhead union.

(5) Install ignition unit (6, fig. 2-74) with clamps (7) on oil cooler support frame and secure with two machine screws and self-locking nuts (5). Connect manifold heater spark plug electrical lead (3), and wiring harness (4). Install wiring harness bracket (9) and secure to oil cooler frame with two machine screws and self-locking nuts (8). Install three assembled washer bolts (1).

(6) Install transmission upper shroud assembly and secure with five assembled washer bolts (fig. 2-73).

(7) Install oil coolers, refer to paragraph 2-27*b*.

(8) Install cooling fan shroud, engine upper covers, cooling fans and cooling fan vanes, refer to paragraph 2-21*b*.

2-29. Intake Manifold Assembly

NOTE

For instructional purposes, replacement of the right intake manifold assembly is described in this section. The left intake manifold assembly is replaced in the same manner.

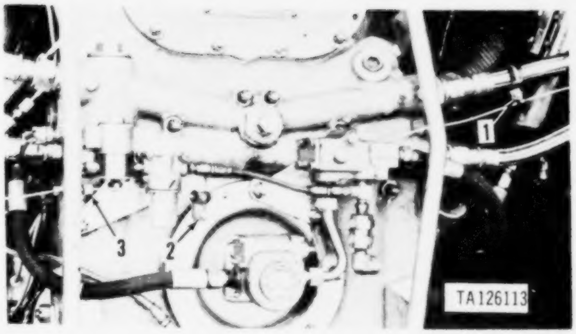
a. Removal.

(1) Remove cooling fan vanes, cooling fans, engine upper covers and cooling fan shroud, refer to paragraph 2-21*a*.

(2) Remove oil coolers. Refer to paragraph 2-27*a*.

(3) Remove oil cooler support frame. Refer to paragraph 2-28*a*.

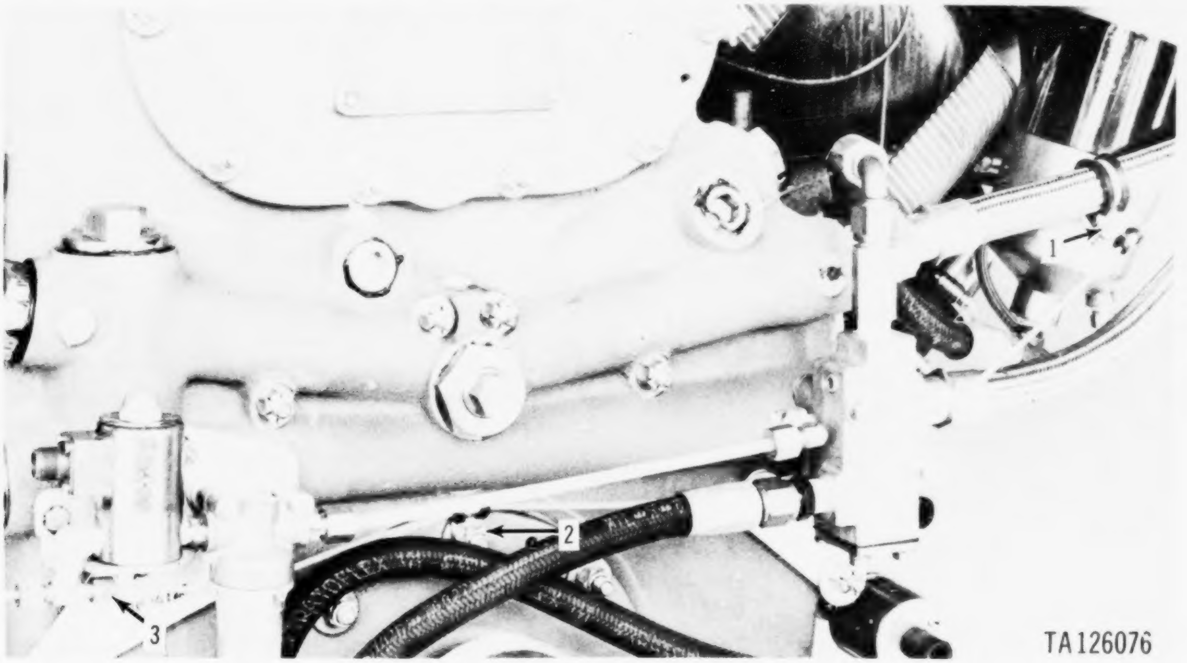
(4) Remove self-locking nut and machine screw (1, fig. 2-79) and self-locking nut and loop clamp (2) and disconnect manifold heater fuel inlet tube (3).



1 Self-locking nut and machine screw
2 Self-locking nut and loop clamp
3 Manifold heater fuel inlet tube

Figure 2-79. Disconnecting or connecting manifold heater fuel inlet tube, model AVDS-1790-2C and AVDS-1790-2D engines.

(4.1) Remove self-locking nut and machine screw (1, fig. 2-79.1). Remove self-locking nut (2) and remove tube clip from stud. Disconnect manifold heater fuel inlet tube nut (3).



1 Self-locking nut and machine screw
2 Self-locking nut
3 Manifold heater fuel inlet tube nut

Figure 2-79.1. Disconnecting or connecting manifold heater fuel inlet tube, model AVDS-1790-2DR engine.

(5) Disconnect cylinder head drain tube. Refer to fig. 2-80.

(6) Loosen two hose clamps (1, fig. 2-81) and slide hose (2) down on lower front drain tube (3). Cut locking wire (4) and remove six body bolts (5) and remove cylinder head oil drain tubes (6) and manifold heater tube (7) as an assembly. Remove and discard twelve gaskets (8).

(7) Loosen four hose clamps (1, fig. 2-82) and separate hoses (2). Slide one hose on the heater tube (3) and the other hose on the turbosupercharger outlet elbow (4). Remove turbosupercharger outlet elbow tube sleeve (5). Remove screw and lockwasher securing cable clamp to spacer on intake manifold.

(8) Remove eighteen nuts and lockwashers (6) and remove intake manifold assembly (7). Remove and discard six cylinder flange gaskets (8).

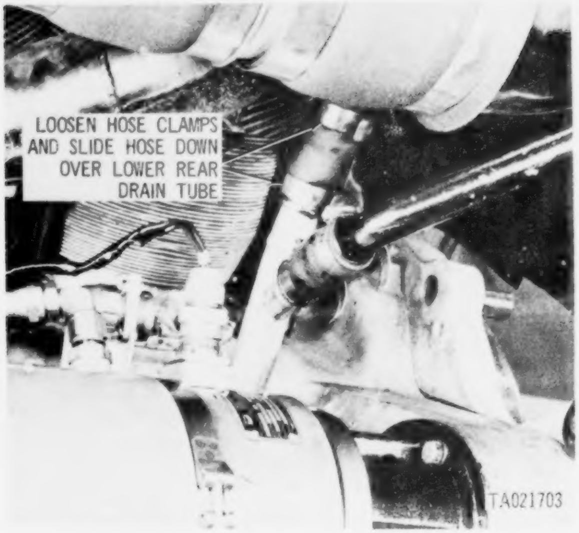
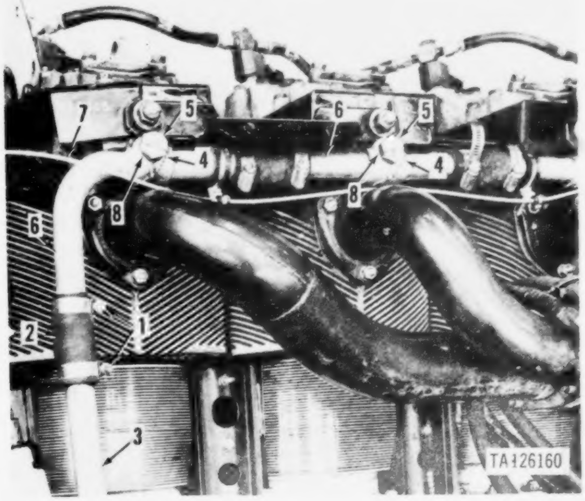


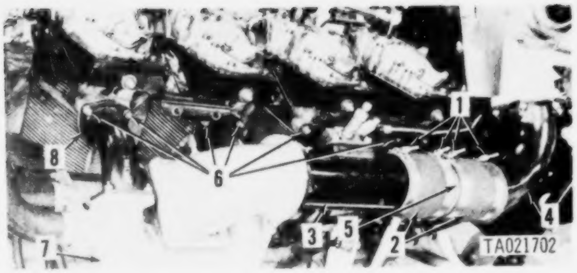
Figure 2-80. Disconnecting or connecting cylinder head oil drain tube – right rear.



1 Hose clamp
2 Hose
3 Lower front drain tube
4 Locking wire
5 Bolt
6 Cylinder head oil drain tube
7 Manifold heater tube
8 Washer

Figure 2-81. Removing or installing cylinder head oil drain tube assembly.

(9) Remove six self-locking nuts and flat washers (fig. 2-83) and remove intake manifold elbow and heater tube as a unit. Remove and discard gasket. Remove eight nuts and remove cylinder 3L and 4L intake manifold tubes. Remove and discard washers. Remove the remaining twelve self-locking nuts securing cylinders 1L, 2L, 5L and 6L tubes to the intake manifold and remove tubes. Remove preformed packing, flat washers, spring washers and manifold flanges from tubes. Discard preformed packings.



1 Hose clamp
2 Hose
3 Intake manifold tube
4 Turbosupercharger outlet elbow
5 Connector tube
6 Nut and lockwasher
7 Intake manifold
8 Gasket

Figure 2-82. Removing or installing intake manifold assembly.

b. Installation.

(1) Install manifold flanges, spring washers, flat washers and new preformed packings on manifold tubes 1L, 2L, 5L, and 6L. Install tubes in intake manifold and secure with twelve self-locking nuts (fig. 2-83). Install new gaskets and install intake manifold tubes for cylinders 3L and 4L. Secure each tube with four self-locking nuts.

(2) Install a new intake manifold elbow gasket, and install intake manifold elbow and heater tube and secure with six self-locking nuts and flat washers.

(3) Install six new cylinder flange gaskets (8, fig. 2-82), and install intake manifold assembly (7) on cylinder studs. Secure intake manifold tubes to cylinders with eighteen plain nuts and lockwashers (6).

(4) Install four hose clamps (1) loosely on two hoses (2). Install both hose assemblies on connector tube (5). Butt the hoses together at the alinement mark on the connector tube (fig. 2-82.1).

(4.1) Install assembled tube and hoses on intake manifold tube (3, fig. 2-82). Install turbosupercharger outlet elbow (4) in tube. Position hoses evenly between alinement marks on the outlet elbow (4) and the intake manifold (3). Position hose clamps (1) 1/8 inch from the ends of the hoses and torque tighten (dry) to 30 - 40 pound-inches.

(5) Install new solid copper washers (8, fig. 2-81) on six body bolts (5) and insert bolts through oil drain tube assembly (6) and install new copper washer (8) on each bolt. Secure drain tube assembly (6) with six bolts and install locking wire (4).

(6) Position hose (2) between cylinder head oil drain tube and lower front drain tube (3) and tighten two hose clamps (1). Position hose (fig. 2-80) between cylinder head oil drain tube and lower rear tube and tighten two hose clamps. Connect

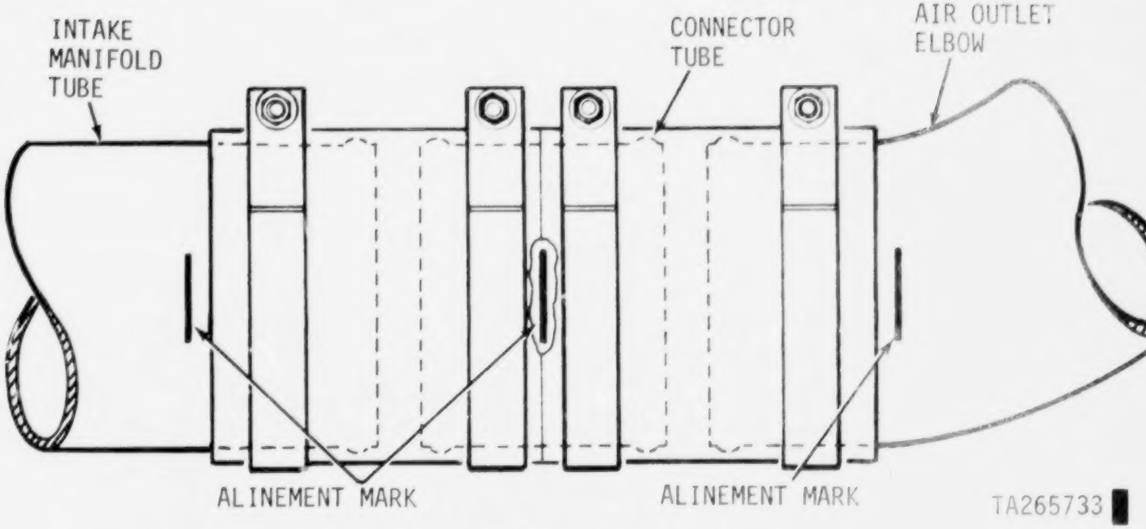

INTAKE MANIFOLD TUBE
CONNECTOR TUBE
AIR OUTLET ELBOW
ALINEMENT MARK
ALINEMENT MARK
TA265733

Figure 2-82.1. Alinement of intake manifold tubes and hoses.

manifold heater fuel inlet tube (3, fig. 2-79) and secure cushioned loop clamp to loop clamp on oil cooler inlet hose with screw and self-locking nut (1). Secure loop clamp to stud with self-locking nut (2).

(6.1) Connect manifold heater fuel inlet tube nut (3, fig. 2-79.1). Position tube clip on stud and secure with self-locking nut (2). Connect tube clip to oil cooler outlet hose clamp and secure with self-locking nut and machine screw (1).

(7) Install oil cooler support frame. Refer to paragraph 2-28*b*.

(8) Install oil coolers. Refer to paragraph 2-27*b*.

(9) Install cooling fan shroud, upper engine covers, cooling fans and cooling fan vanes. Refer to paragraph 2-21*b*.

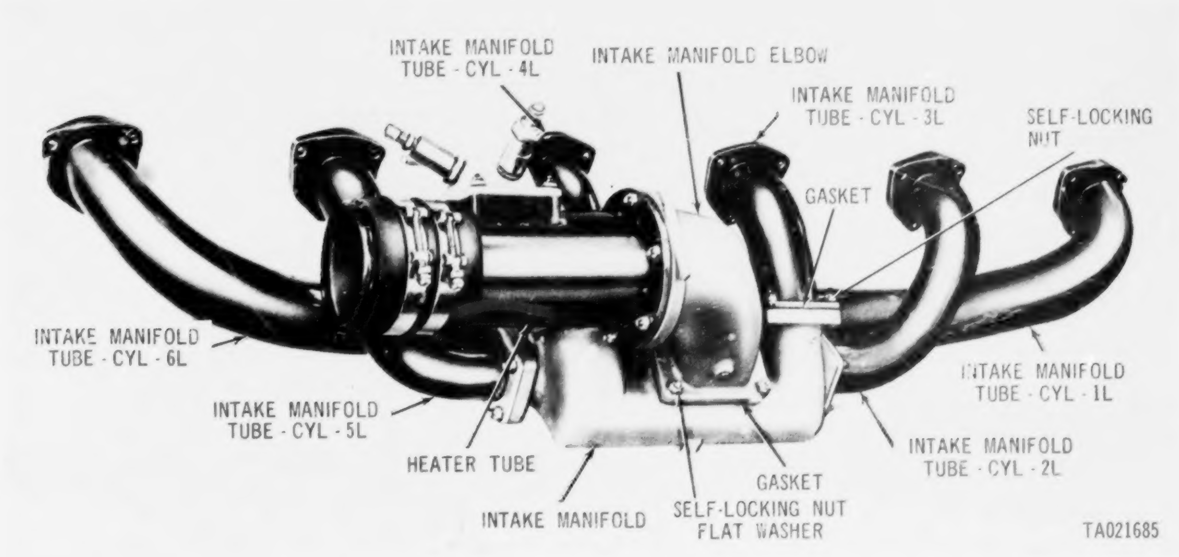

INTAKE MANIFOLD TUBE - CYL - 4L
INTAKE MANIFOLD ELBOW
INTAKE MANIFOLD TUBE - CYL - 3L
SELF-LOCKING NUT
GASKET
INTAKE MANIFOLD TUBE - CYL - 6L
INTAKE MANIFOLD TUBE - CYL - 1L
INTAKE MANIFOLD TUBE - CYL - 5L
INTAKE MANIFOLD TUBE - CYL - 2L
HEATER TUBE
GASKET
INTAKE MANIFOLD
SELF-LOCKING NUT
FLAT WASHER
TA021685

Figure 2-83. Disassembling or assembling intake manifold assembly.

2-30. Intercylinder Fuel Return Lines, Valve Rocker Arms, Rocker Arm Shafts or Valve Clearance Adjusting Screws

a. Removal.

(1) Remove cooling fan vanes, cooling fans, engine upper covers and cooling fan shroud. Refer to paragraph 2-21*a*.

(2) Remove oil coolers. Refer to paragraph 2-27*a*.

(3) Remove oil cooler support frame. Refer to paragraph 2-28*a*.

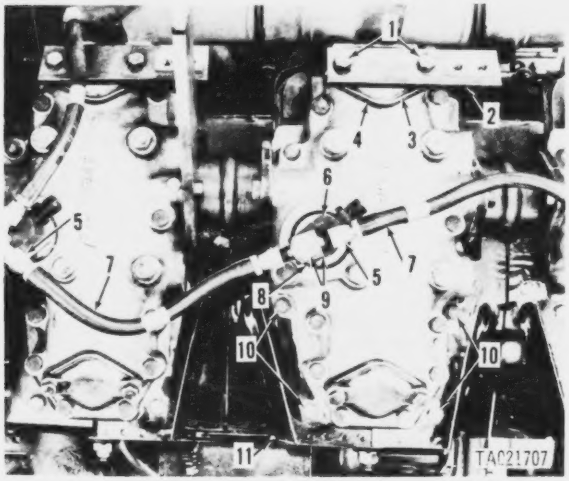
(4) Remove fuel injector tubes. Refer to paragraph 2-21*a* (7) through (10).

NOTE

All rocker arms, shafts and adjusting screws are removed and installed in the same manner. For instructional purposes the removal of only one is described.

(5) Remove two machine bolts (1, fig. 2-84), support (2) and access cover (3). Remove and discard gasket (4). Disconnect fuel injector nozzle fuel return hose nut (5) at nozzle connector (6) and remove and retain fuel return hose (7). Remove nozzle connector bolt (8) and nozzle connector (6). Remove and discard two gaskets (9). Remove four assembled washer bolts (10) and remove two cylinder head shroud plates (11).

(6) Loosen and remove fuel injector nozzle and holder assembly as shown in figure 2-85. Remove and discard flat washer (gasket) (fig. 2-86) and preformed packing.



1 Machine bolt
2 Support
3 Access cover
4 Gasket
5 Return hose nut
6 Nozzle connector
7 Fuel return hose
8 Nozzle connector bolt
9 Gasket
10 Assembled washer bolt
11 Cylinder head shroud plate

Figure 2-84. Removing or installing fuel injector nozzle return hose, tube connector and cylinder head shroud plate.

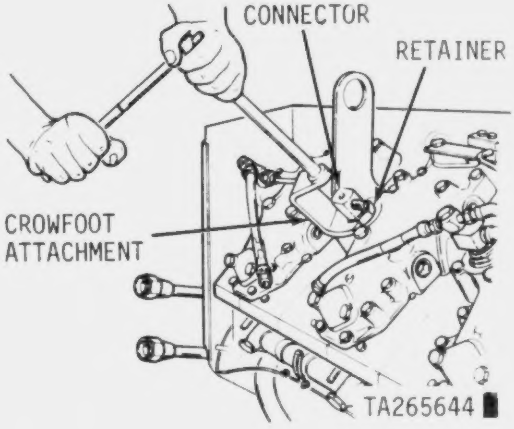


Figure 2-85. Loosening fuel injector nozzle and holder assembly using crowfoot attachment.

NOTE

In stubborn cases, when the nozzle is heavily carboned, remove the fuel inlet connector from the nozzle body and remove the nozzle body. Remove the nozzle retainer using wrench socket, Part No. 11610171. Turn the shaft of puller assembly, Part No. 12275805 counterclockwise to the end of the thread. Install puller over capnut and rest on nozzle insert. Turn puller shaft clockwise and engage capnut threads until puller shaft bottoms. Using open end wrench, turn puller plain nut clockwise (fig. 2-85.1) to remove capnut and associated parts.

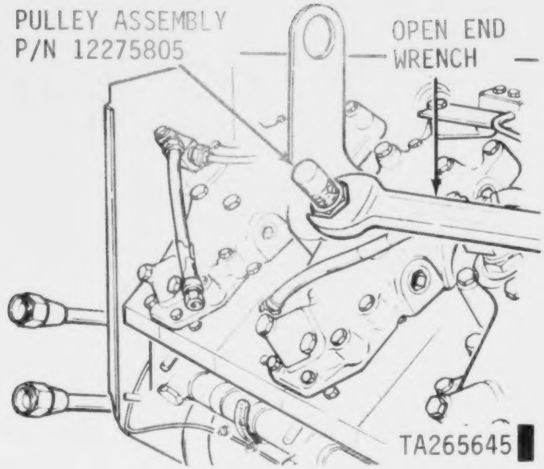


Figure 2-85.1. Removing fuel injector nozzle capnut with puller assembly.

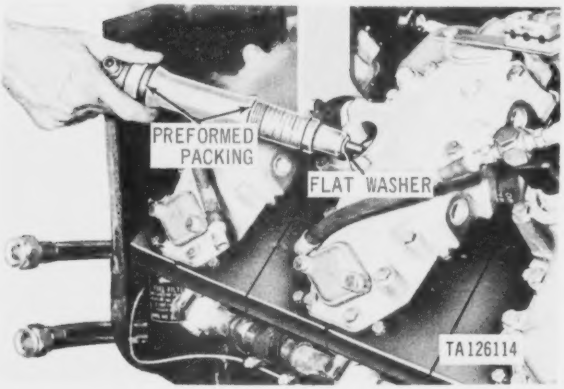
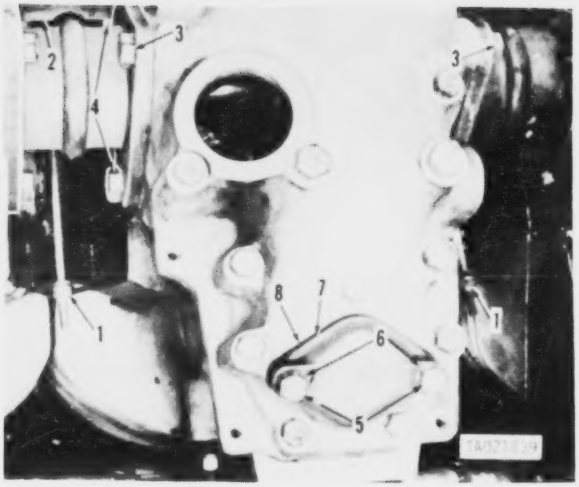


Figure 2-86. Removing or installing fuel injector nozzle and holder assembly.

(7) Remove two self-locking nuts (1, fig. 2-87), and lift two air deflectors (2) from cylinder fins and rocker arm covers. It is not necessary to remove deflectors.

(8) Remove two outer machine screws (3) and loosen four machine screws (4). Remove two machine bolts (5) and two washers (6) and remove access cover (7). Remove and discard gasket (8).



1 Self-locking nut
2 Air deflector
3 Outer machine screw
4 Machine screw
5 Machine bolt
6 Washer
7 Access cover
8 Gasket

Figure 2-87. Removing or installing intake valve access covers.

(9) Separate intercylinder connector flanges (1, fig. 2-88). Using a piece of shim stock, loosen flanges of intercylinder sleeve (2).

CAUTION

Do not damage sealing surface on flange of intercylinder sleeve as it will cause leaks and the replacement of the sleeve will be required.

(10) Remove four machine bolts and lockwashers (3). Remove seven machine bolts and flat washer (4) and two machine screws and flat washers (5).

NOTE

One valve rocker arm cover retaining machine screw and flat washer, and the associated machining, have been eliminated from the cylinder assembly on late engines. The machine screw that has been eliminated is marked X on figure 2-88.

(11) Turn the engine flywheel to release the tension on the valve rocker arms, caused by the valve springs. Using splined wrench, Part No. 10882747 (fig. 2-42), turn flywheel until valve rocker arm rollers are on the camshaft base circle, or until both valves are closed.

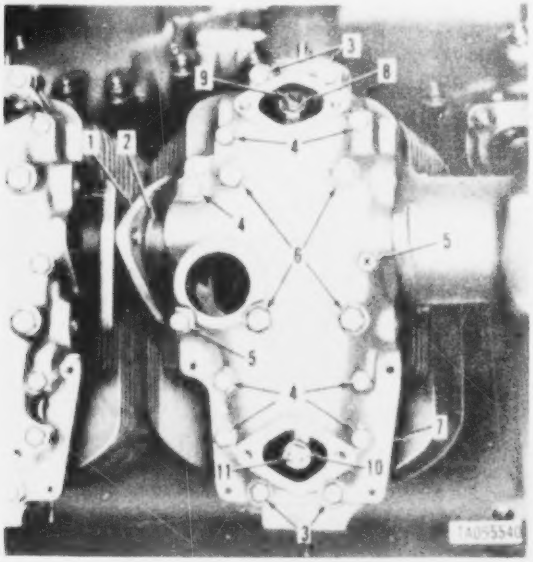
(11.1) Turn the engine crankshaft to release valve spring tension on the valve rocker arms. Position improvised engine turning tool (1, fig. 2-42.1) on power takeoff coupling and secure with four

7/16-20UNF x 1-½ inch machine bolts (2). Install a 1¼-inch socket (3) and turn crankshaft until valve rocker arm rollers are on the camshaft base circle, or until both valves are closed.

NOTE

> Check rocker arms to see that they move up and down. If movement (clearance cannot be felt, turn engine until clearance is evident. When clearance is obtained between both adjusting screw pads and valve stem, the rocker arm rollers are on the camshaft base circle, and the valves are completely closed.

(12) Remove four machine bolts and packing with retainer (6, fig. 2-88) and remove valve rocker arm cover (7).


1
3
9
8
4
1
2
4
6
5
5
4
7
11
10
3
TA055540

1 Intercylinder connector flange
2 Intercylinder sleeve
3 Machine bolt and lockwasher
4 Machine bolt and flat washer
5 Machine screw and flat washer
6 Machine bolt, packing and retainer
7 Valve rocker arm cover
8 Adjusting screw lock nut
9 Exhaust valve adjusting screw
10 Adjusting screw lock nut
11 Intake valve adjusting screw

Figure 2-88. Removing or installing valve rocker arm cover.

(13) Remove valve adjusting screw as shown in figure 2-89.

NOTE

> Valve rockers do not have to be removed to replace adjusting screws.

(14) Remove two valve rocker arm shaft plugs (fig. 2-90) and remove rocker arm shafts and rocker arms (fig. 2-91).

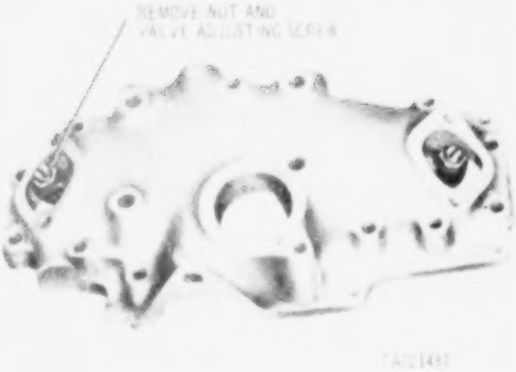

REMOVE NUT AND
VALVE ADJUSTING SCREW
TA021487

Figure 2-89. Removing or installing valve adjusting screw.

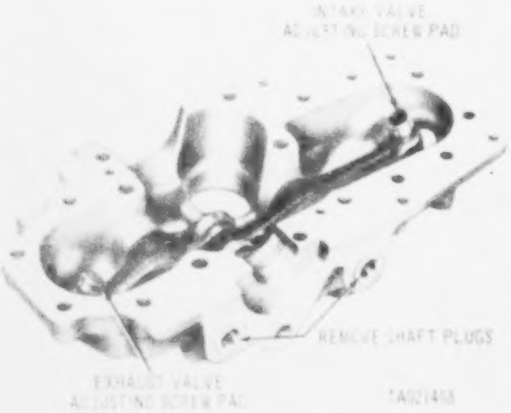

INTAKE VALVE
ADJUSTING SCREW PAD
REMOVE SHAFT PLUGS
EXHAUST VALVE
ADJUSTING SCREW PAD
TA021468

Figure 2-90. Removing or installing valve rocker arm shaft plugs.

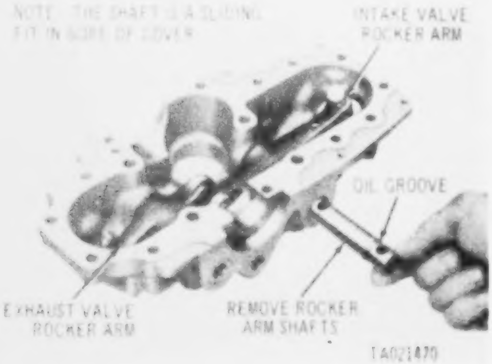

NOTE: THE SHAFT IS A SLIDING
FIT IN BORE OF COVER
INTAKE VALVE
ROCKER ARM
OIL GROOVE
EXHAUST VALVE
ROCKER ARM
REMOVE ROCKER
ARM SHAFTS
TA021470

Figure 2-91. Removing valve rocker arm shafts and valve rocker arms.

b. Installation.

NOTE

The cylinder and valve rocker arm cover are machined as an assembly. The number on the rocker cover must be kept with its mating number on the cylinder to insure camshaft bearing alinement and running clearance. If rocker arm cover is damaged the entire cylinder and cover must be replaced.

(1) Position valve rocker arms in rocker arm cover and insert valve rocker arm shaft (fig. 2-92) through bore in rocker arm cover and rocker arm. Use one rocker arm cover bolt (fig. 2-92) to aline hole in shaft with bolt hole in cover. Push shaft into position without twisting, to retain alinement. Install rocker arm shaft plugs (fig. 2-90) and valve adjusting screws (fig. 2-89).

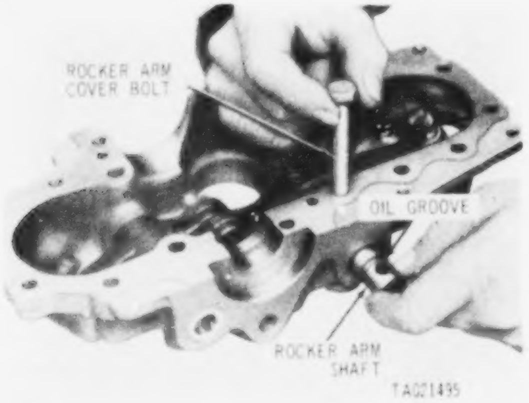


Figure 2-92. Installing valve rocker arms in rocker cover.

(2) Coat face of valve rocker arm cover with cement Mil-C-10523 (Ord). Install valve rocker arm cover being careful not to damage lip of intercylinder sleeve (2, fig. 2-88) on each side of the cylinder. Tap valve rocker arm cover gently into position on locating dowel pins being sure cover is flush with mating surface of cylinder.

(3) Position lip of intercylinder sleeve (2) using shim stock.

(4) Secure valve rocker arm cover with four bolts and packings with retainer (6) and tighten to 275-325 pounds inch-torque. Install screw and flat washer (5) and tighten to 100 pounds-inch torque. Install four bolts and lockwashers (3) and tighten to 100 pounds-inch torque.

(5) Make certain adjusting screw pad is positioned squarely on end of valve stem. Loosen exhaust valve adjusting screw lock nut (8). Turn valve adjusting screw (9) until clearance between screw pad and valve stem is 0.025 inch (para 2-52). Torque lock nut to 175 pounds-inch after correct adjustment is made. Make certain setting has not changed after tightening lock nut.

(6) Loosen intake valve adjusting screw lock nut (10) and turn valve adjusting screw (11) until clearance between screw pad and valve stem is 0.010 inch (para 2-52). Torque lock nut to 175 pounds-inch after correct adjustment is made.

(7) Position intercylinder connector flanges on valve rocker cover and secure with two outer screws (3, fig. 2-87) and tighten the inner four connector flange screws (4). Install intake valve adjusting screw access cover (7) using new gasket (8) with two bolts (5) and flat washers (6).

(8) Position two air deflectors (2) between cylinder fins and rocker arm covers and secure with two nuts (1).

NOTE

Use only the solid copper flat washer (gasket) Part No. 7748837 for replacement whenever the fuel injector nozzle and holder assembly has been removed from the cylinder. The solid copper flat washer (gasket) conforms to the specific contours of the nozzle cylinder head seat in an individual installation. Because of this, it is the only approved gasket for this function and should never be reused. Before installing new gasket in cylinder nozzle seat, always check to be sure that original gasket has been removed since an inadvertent installation of two seating gaskets would damage the fuel injector nozzle retaining spring. Check to be sure cylinder nozzle seat is free from excessive carbon deposit and that the seat face is free from surface roughness. Remove carbon deposits and/or surface roughness using nozzle carbon cutter Part No. 10882949 (para 3-70).

(9) Install two new preformed packings (fig. 2-86) on fuel injector nozzle holder. Install a new flat copper washer, hold in place with a light coating of grease. Install fuel injector nozzle and holder assembly, do not torque tighten until the fuel injector lines are installed.

(10) Install two cylinder head shroud plates (11, fig. 2-84) and secure with four assembled washer bolts (10). Install new gasket (9) on nozzle connector bolt (8) and install bolt through nozzle connector (6). Install bolt and connector on fuel injector nozzle using new gasket (9). Install fuel return hose (7) and tighten hose nuts (5).

(11) Install exhaust valve adjusting screw access cover (3, fig. 2-84) using new gasket (4). Install support (2) and two bolts (1).

(12) Install fuel injector tubes. Torque tighten fuel injector nozzles to 500 pound-inches. Install cooling fan shroud, engine upper covers, cooling fans, and cooling fan vanes. Refer to para 2-21*b*.

(13) Install oil cooler support frame. Refer to para 2-28*b*.

(14) Install oil cooler. Refer to para 2-27*b*.

2-31. Oil Filter Elements

a. Removal.

(1) Place engine on suitable blocks prior to draining oil.

NOTE

Provide suitable container with approximately 20 gallon capacity (minimum). Remove oil pan drain plug (fig. 2-93) and drain oil.

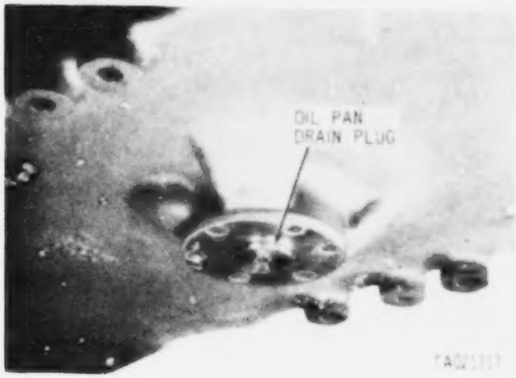


Figure 2-93. Oil pan drain plug location.

(2) Remove oil vent capscrew and seal washer (fig. 2-94). Remove and discard seal washer. Loosen oil drain valve six complete turns and allow oil to drain at the oil pan drain plug opening. Do not loosen oil drain valve adapter.

(3) Remove ten self-locking nuts and flat washers and remove cover.

(4) If necessary fabricate two 3/8-24 puller screws and install as shown in figure 2-95, and remove cover.

(5) Remove and discard gasket (fig. 2-96). Remove and discard oil filter elements. Clean filter body with a suitable clean, lint-free cloth being careful not to drop any foreign particles into drain holes.

b. Installation.

(1) Install two new oil filter elements (fig. 2-96), using new cover gasket. Install cover (fig. 2-94) and secure with ten self-locking nuts and flat washers.

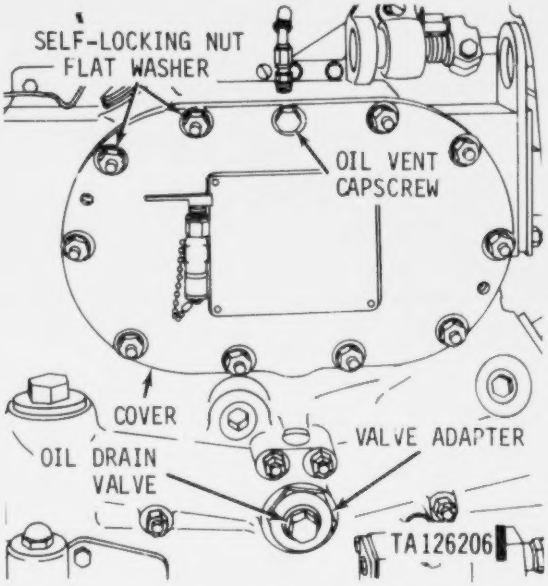


Figure 2-94. Draining oil filter housing and oil coolers.

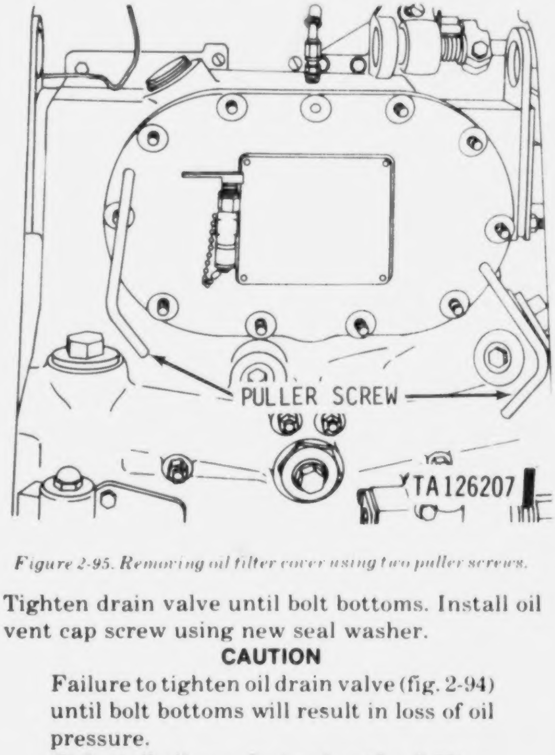


Figure 2-95. Removing oil filter cover using two puller screws.

Tighten drain valve until bolt bottoms. Install oil vent cap screw using new seal washer.

CAUTION

Failure to tighten oil drain valve (fig. 2-94) until bolt bottoms will result in loss of oil pressure.

(2) Install oil pan drain plug (fig. 2-93).

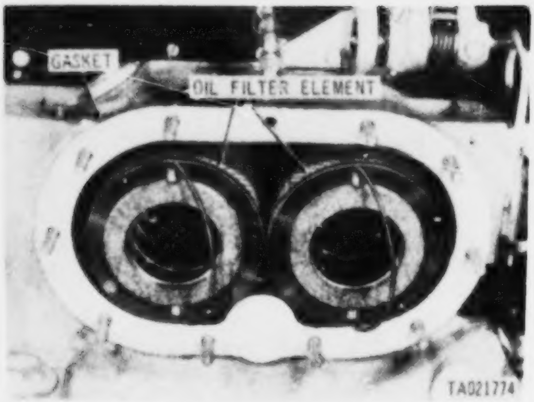


Figure 2-96. Installing oil filter elements.

2-32. Flywheel and Crankshaft Oil Seal

a. Removal.

(1) Turn flywheel using splined wrench, Part No. 10882747 (fig. 2-42) until lifting eye bolt hole (fig. 2-97) is located on top. Straighten tabs of lock plates and remove nine bolts and three lock plates attaching transmission drive spur gear and flywheel to crankshaft. Discard lock plates.

(1.1) Position improvised engine turning tool (1, fig. 2-42.1) on power takeoff coupling and secure with four 7/16-20UNF x 1-1/2 inch machine bolts (2). Install a 1 1/4-inch socket (3) and turn crankshaft until flywheel lifting eye bolt hole is on top. Install lifting eye bolt, Part No. MS51937-7 (fig. 2-97.1). Install a suitable chain fall and attach to the lifting eye bolt. Cut locking wire, remove eight machine bolts and remove flywheel (fig. 2-97.1). Remove lifting eye bolt from flywheel. Remove improvised engine turning tool.

(2) Install three of the nine bolts (fig. 2-97) into puller screw holes and remove transmission drive spur gear from crankshaft dowel pins by alternately tightening the three bolts.

(3) Install three bolts (fig. 2-98) from transmission drive spur gear and flywheel, into puller holes. Alternately tighten bolts until flywheel is far enough from crankshaft dowel pins to permit installation of lifting eye bolt. Install lifting eye bolt, Part No. MS51937-7 and remove flywheel. Remove lifting eye bolt from flywheel.

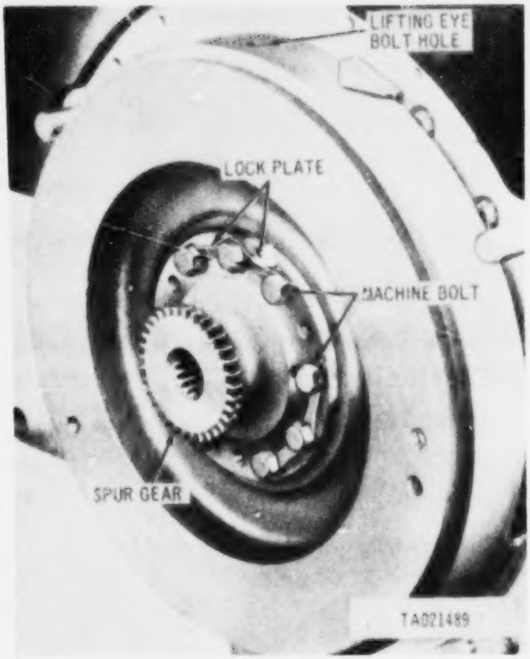


Figure 2-97. Removing transmission drive spur gear, model AVDS-1790-2C and AVDS-1790-2D engines.

(3.1) Straighten tabs of three lock plates (fig. 2-98.1) and remove nine machine bolts securing flywheel adapter to crankshaft. Discard lock plates. Install three of the machine bolts (removed above) in the flywheel adapter puller screw holes (fig. 2-98.2). Alternately tighten the bolts and pull the adapter from the dowel pins. Remove machine screws from adapter.

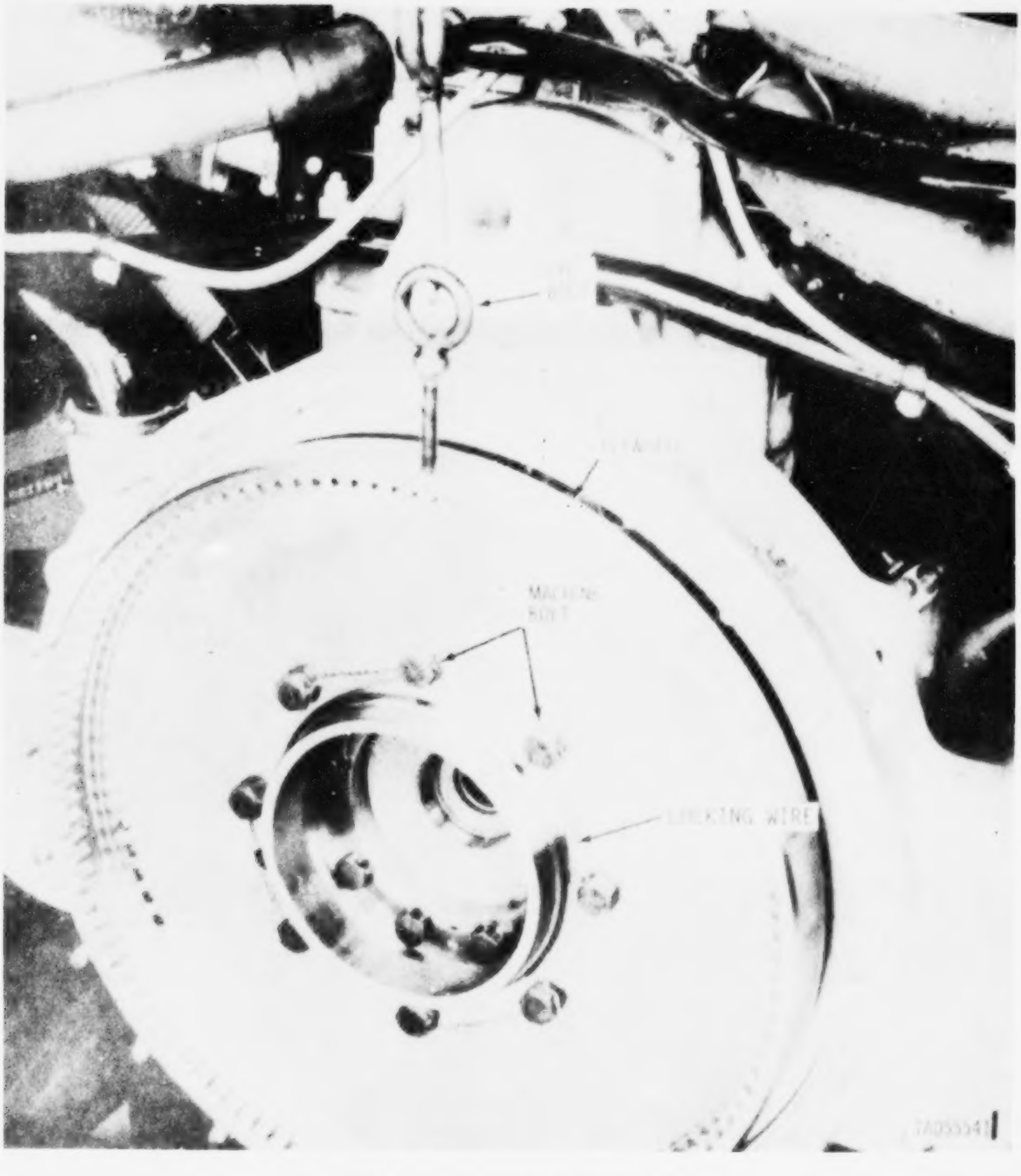


Figure 2-97.1. Removing or installing flywheel, model AVDS-1790-2DR engine.

(4) Cut locking wire and remove three bolts (fig. 2-99) securing oil seal retainer to oil seal cap. Cut locking wire and remove three bolts securing retainer to oil seal housing, and remove retainer.

(5) Cut locking wire and remove four slotted nuts and flat washers (fig. 2-100) attaching oil seal cap to oil seal housing. Cut locking wire and remove twenty machine bolts and flat washers attaching oil seal cap and housing to crankcase.

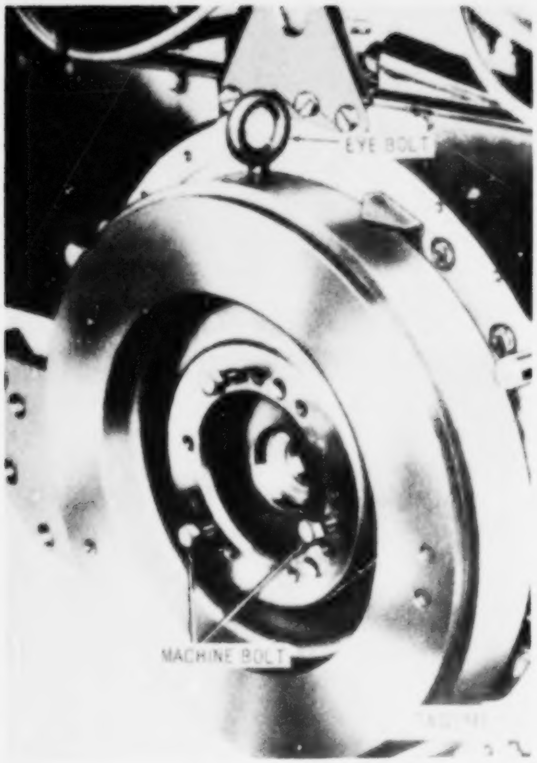

EYE BOLT
MACHINE BOLT

Figure 2-98. Removing flywheel, model AVDS-1790-2C and AVDS-1790-2D engines.

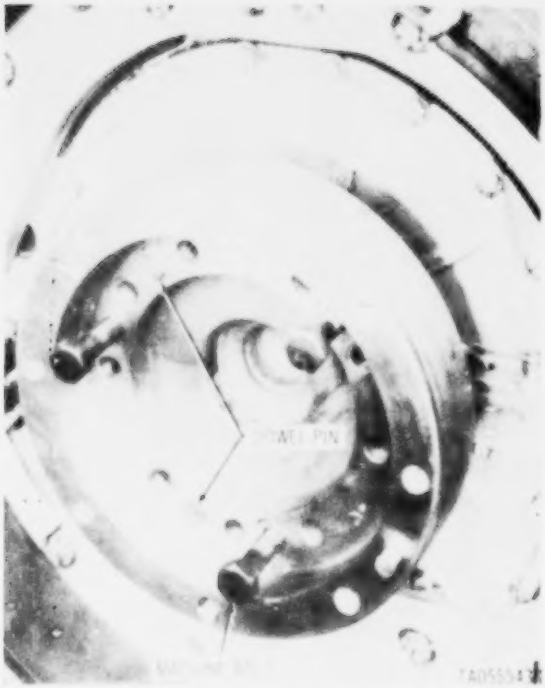

DOWEL PIN
MACHINE BOLT
TA055543

Figure 2-98.2. Removing flywheel adapter, model AVDS-1790-2DR engine.

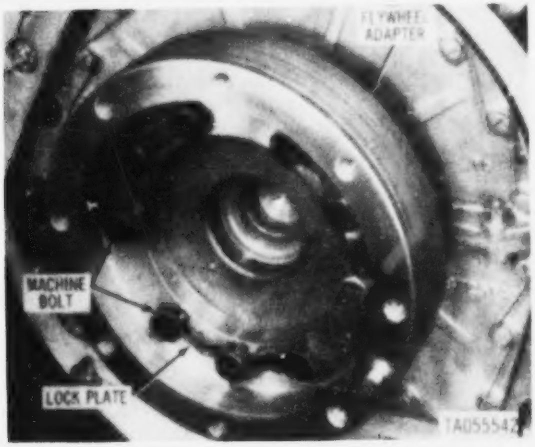

FLYWHEEL ADAPTER
MACHINE BOLT
LOCK PLATE
TA055542

Figure 2-98.1. Removing flywheel adapter lock plates and machine bolts, model AVDS-1790-2DR engine.

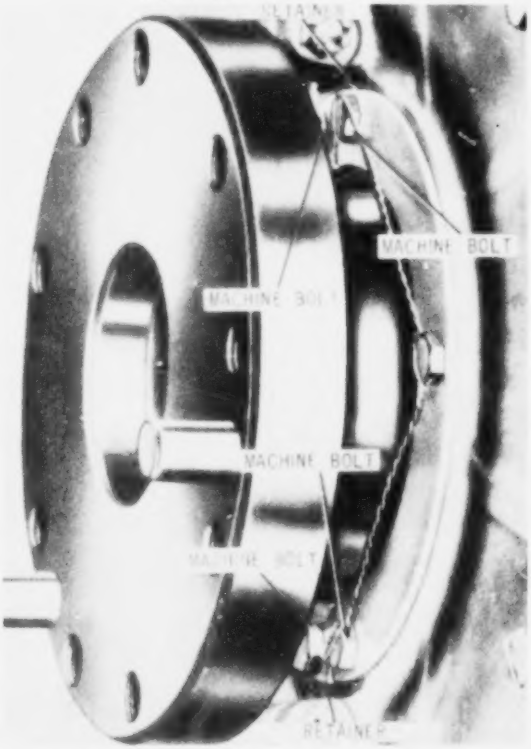

RETAINER
MACHINE BOLT
MACHINE BOLT
MACHINE BOLT
MACHINE BOLT
RETAINER

Figure 2-99. Removing or installing oil seal retainers.

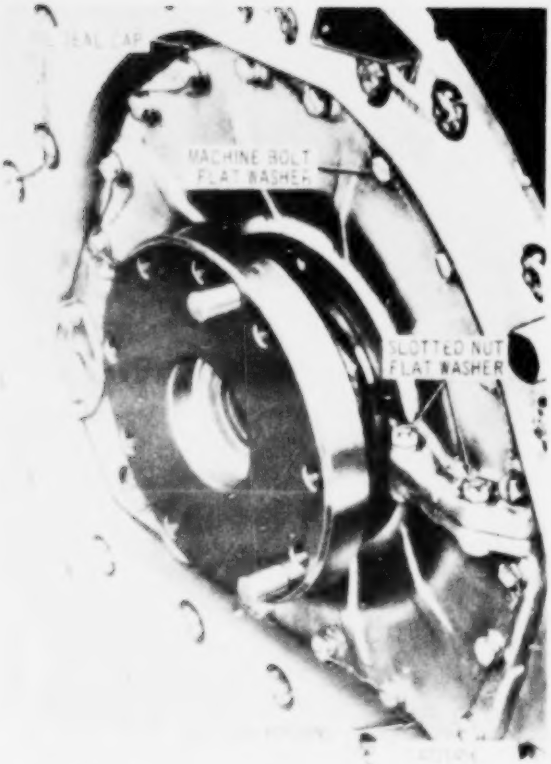


Figure 2-100. Removing or installing oil seal cap and oil seal housing mounting bolts.

(6) Install two mechanical pullers, Part No. 5739997 (fig. 2-101) and pull cap and housing free of dowel pins. Remove mechanical pullers and separate oil seal cap from dowel pins in housing and remove housing cap and housing as shown in figure 2-102. Remove and discard gasket.

(7) Remove spring (fig. 2-103) from lip in crankshaft oil seal and remove split oil seal from crankshaft. Position oil seal spring (fig. 2-104) (male and female) to facilitate removal. Twist male end clockwise and female end counterclockwise and remove spring.

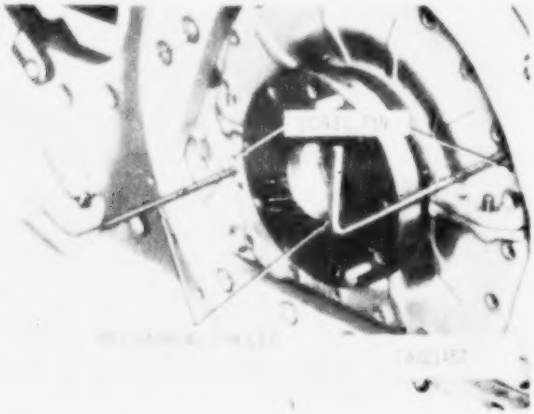


Figure 2-101. Removing oil seal housing using mechanical pullers.

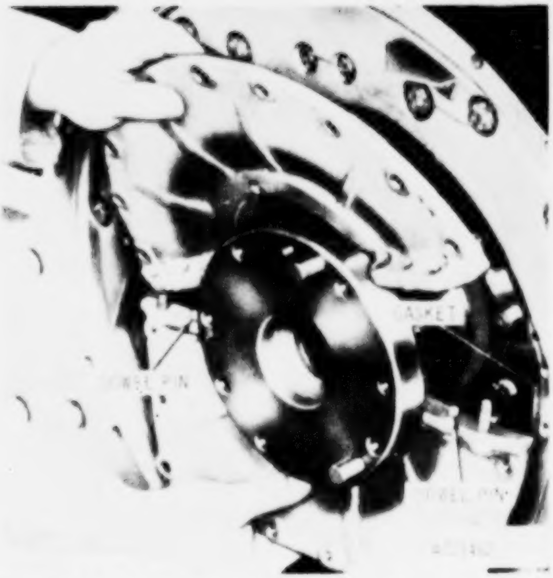


Figure 2-102. Removing or installing oil seal housing cap and housing.

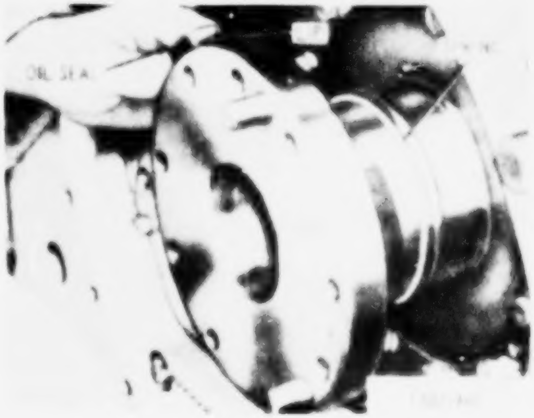


Figure 2-103. Removing or installing crankshaft oil seal.

b. Installation.

(1) Position oil seal spring (fig. 2-105) around crankshaft and interlock ends. Secure spring by twisting female end of spring clockwise and male end counterclockwise.

(2) Install split oil seal (fig. 2-103), making sure that the lip is toward the crankcase and that the spring seats around the lip of the oil seal. Apply a coating of lubricant (engine oil) around lip and outer surface of seal.

NOTE

Oil seal must be rotated on crankshaft

until ends of oil seal join 30° from centerline of crankshaft looking at the flywheel end of the engine as shown in figure 2-106.

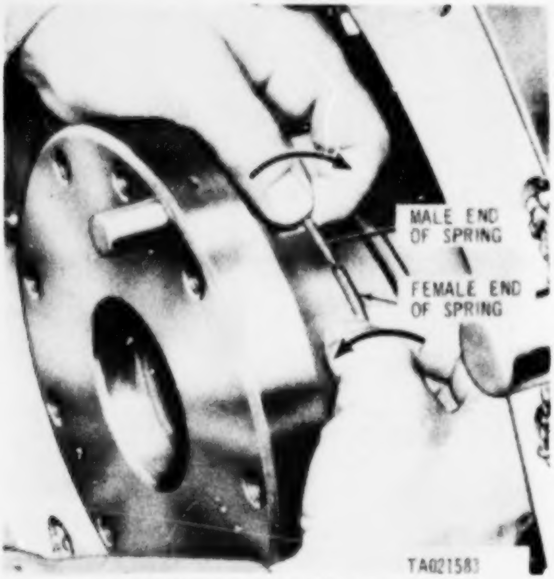


Figure 2-104. Removing crankshaft oil seal spring.

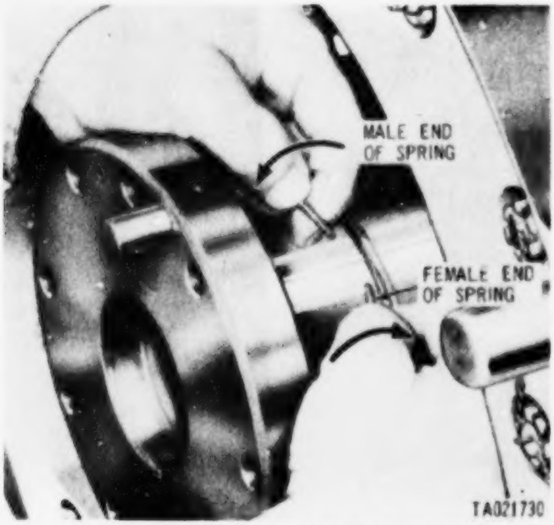


Figure 2-105. Installing crankshaft oil seal spring.

(3) Install oil seal housing and oil seal housing cap (fig. 2-102) using new gasket, over oil seal and on dowel pins. Secure oil seal housing cap and housing to crankcase with twenty bolts and flat washers (fig. 2-100). Secure bolts with locking wire.

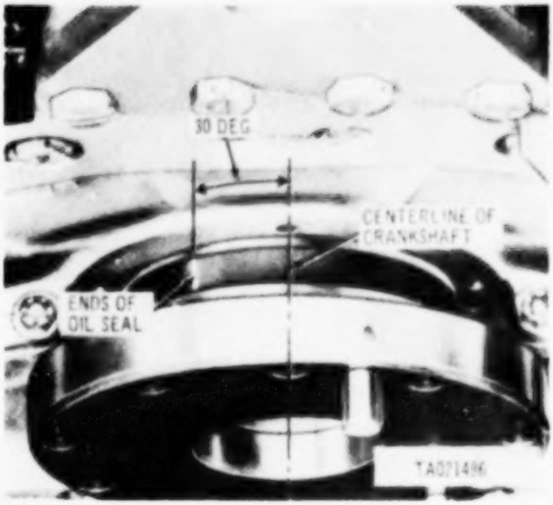


Figure 2-106. Correct position for crankshaft oil seal split line before installing seal retainer.

Secure oil seal cap to oil seal housing with four nuts and flat washers and secure nuts with locking wire.

(4) Install oil seal retainer over oil seal and secure to oil seal cap with three bolts (fig. 2-99) and install locking wire. Install the remaining oil seal retainer on the oil seal housing and secure with three bolts. Install locking wire.

(5) Position flywheel on crankshaft and draw flywheel to crankshaft by installing three transmission drive spur gear and flywheel bolts and alternately tighten about one turn at a time to draw flywheel on dowel pins without binding (fig. 2-107). Remove bolts and install transmission drive spur gear following the above procedure until both flywheel and transmission drive spur gear are properly alined on dowel pins.

(5.1) Position flywheel adapter on crankshaft dowel pins (fig. 2-98.2). Install three flywheel adapter machine bolts 120° apart and tighten bolts alternately until the adapter is seated on the crankshaft. Remove the bolts. Install three new lock plates and nine machine bolts (fig. 2-98.1). Torque tighten bolts to 1000 pound-inches and secure bolts by bending lock plate tabs against bolt heads.

(5.2) Install lifting eye bolt in flywheel and install flywheel on crankshaft with dowel pin alined. Install eight machine bolts and torque tighten to 1000 pound-inches. Install locking wire as shown in figure 2-97.1. Remove lifting eye bolt from flywheel.

Figure 2-107. Installing flywheel and transmission drive spur gear on crankshaft.

(6) Secure transmission drive spur gear and flywheel to crankshaft with three new lockplates (fig. 2-97) and nine bolts and torque tighten to 1000 pound-inches. Secure nine bolts by bending tabs of lockplates.

2-33. Oil Pressure Regulator Valve

WARNING

The valve cover is spring loaded. Exercise care when removing cover.

a. Removal.

(1) Remove two self-locking nuts (fig. 2-108) and flat washers attaching cover to crankshaft damper and oil filter housing. Remove cover, shim washers and gasket. Remove and discard gasket.

(2) Remove stop, spring, valve, and valve sleeve.

NOTE

The valve sleeve may be difficult to remove because of the presence of varnish from the oil. An improvised tool (fig. 2-3) used with mechanical puller, Part No. 8708712 may be used to assist in removing valve sleeve. Insert hook end of tool into hole in sleeve and gently tap until sleeve is free.

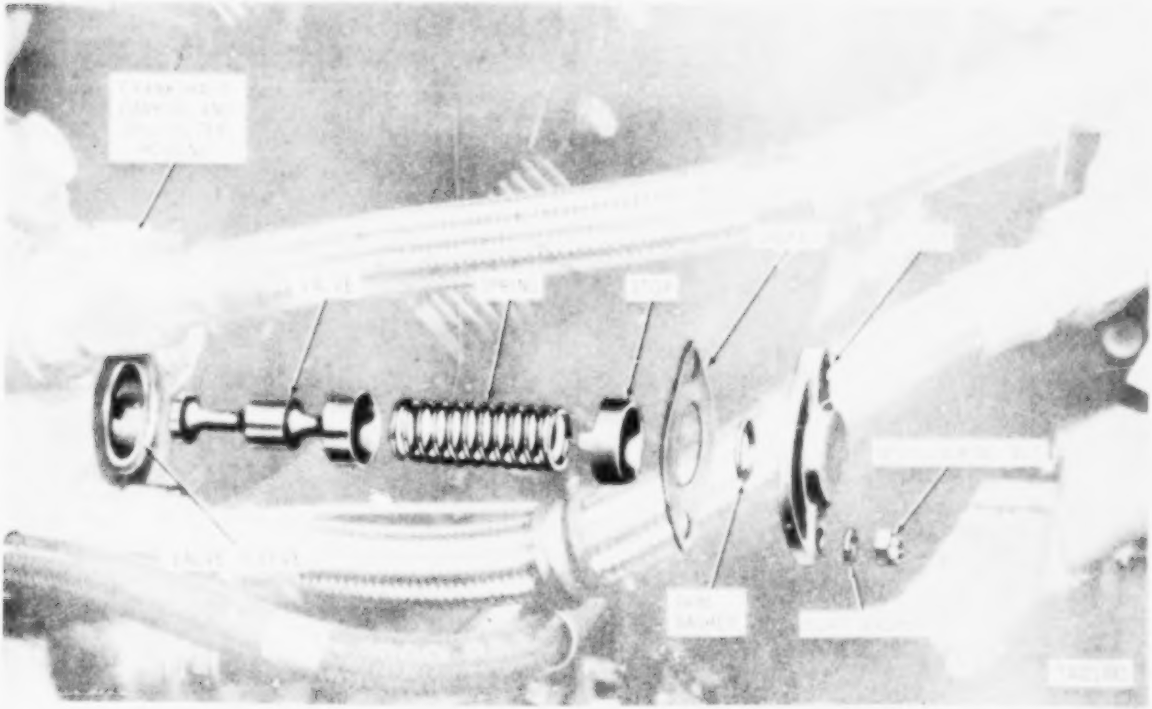


Figure 2-108. Removing or installing oil pressure regulator valve.

b. Installation.

NOTE

To increase engine oil pressure, one or more shim washers can be installed between the cover and the spring. To decrease oil pressure, remove shim washers. Refer to paragraph 1-24 for recommended oil pressures.

(1) Install valve sleeve (fig. 2-108), valve, spring, and stop. Install shim washers and cover using new gasket.

(2) Install two self-locking nuts and flat washers securing cover to crankshaft damper and oil filter housing.

2-34. Oil Filter Bypass Valve

a. Removal.

(1) Remove oil filter bypass plug (fig. 2-109). Remove and discard gasket.

(2) Remove bypass valve spring and bypass valve.

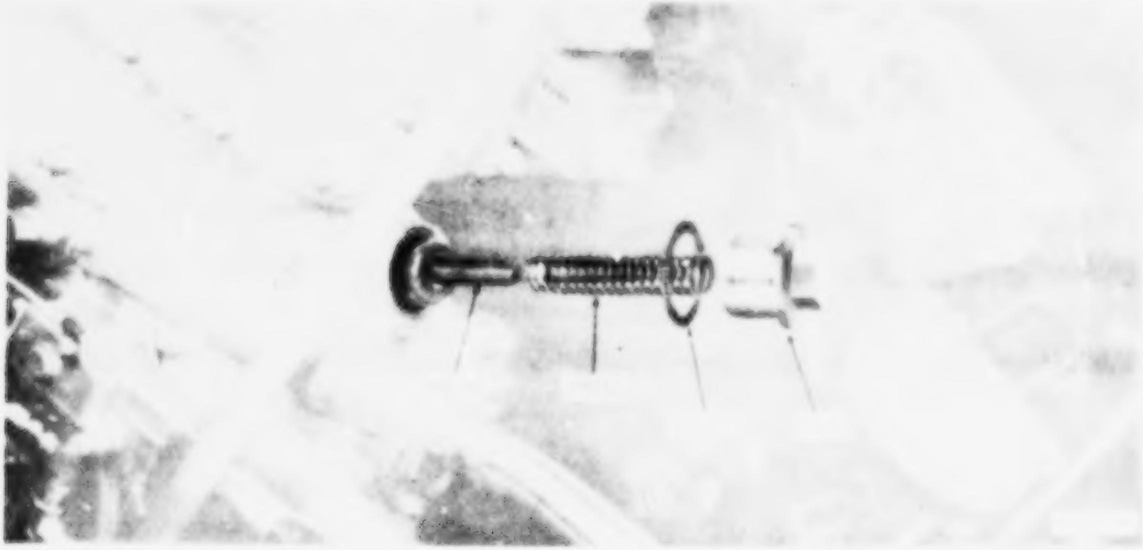


Figure 2-109. Removing or installing oil filter bypass valve.

b. Installation.

(1) Install bypass valve (fig. 2-109). Position bypass valve spring on valve.

(2) Install plug using new gasket.

2-35. Oil Cooler Bypass Valve

a. Removal.

(1) Remove oil cooler bypass plug (fig. 2-110). Remove and discard gasket.

(2) Remove bypass valve spring and bypass valve.

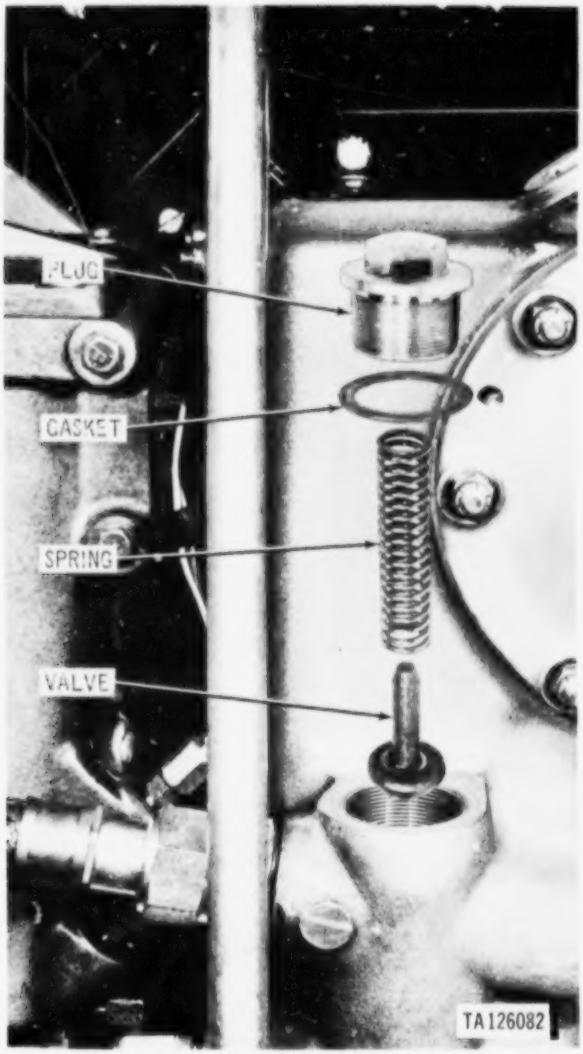


Figure 2-110. Removing or installing oil cooler bypass valve.

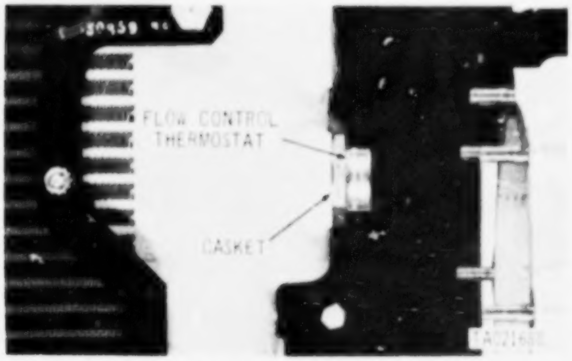


Figure 2-111. Removing or installing transmission oil cooler flow control thermostat.

b. Installation.

(1) Install bypass valve (fig. 2-110) Position bypass valve spring on valve.

(2) Install plug using new gasket.

2-36. Transmission Oil Cooler Flow Control Thermostat

a. Removal.

(1) Remove flow control thermostat (fig. 2-111).

(2) Remove and discard gasket.

b. Installation.

(1) Position new gasket on flow control thermostat (fig. 2-111).

(2) Install thermostat.

2-37. Engine Oil Cooler Thermostatic Valve Assembly

a. Removal.

(1) Remove thermostatic valve assembly valve

(fig. 2-112).

(2) Remove and discard gasket.

NOTE

It is necessary to remove the left bank engine oil cooler before the thermostatic valve can be removed. Refer to paragraph 2-27*a* for oil cooler removal.

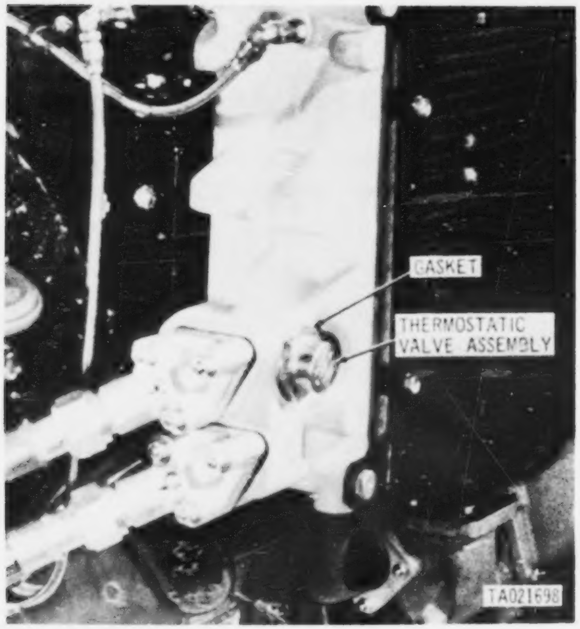


Figure 2-112. Removing or installing engine oil cooler thermostatic valve assembly.

b. Installation.

(1) Position new gasket on thermostatic valve assembly (fig. 2-112).

(2) Install valve. Install left bank engine oil cooler (para 2-27*b*).

2-38. Cooling Fans, Fan Drive Oil Seal, or Fan Clutch Bearing

a. Removal.

NOTE

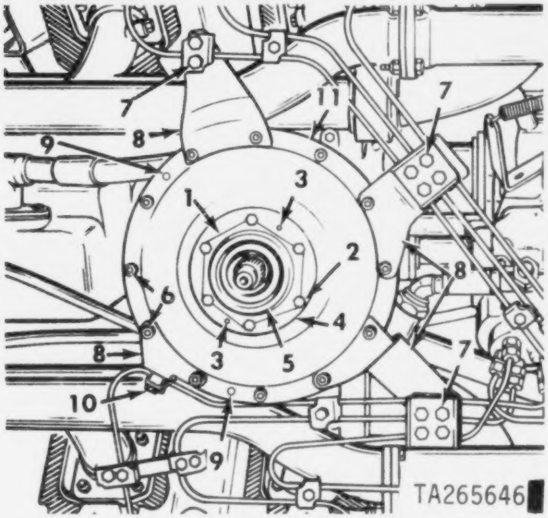
The front and rear fans, and clutch assemblies are interchangeable and are removed in a similar manner. For instructional purposes removal of the rear fan clutch is described in this section.

(1) Remove cooling fan vane and cooling fan. Refer to paragraph 2-21*a*.

(2) Cut locking wire (1, fig. 2-113) and remove six machine bolts and flat washers (2). Install two mechanical pullers, Part No. 5739997 in screw holes (3). Turn pullers alternately and remove oil seal housing (4). Remove oil seal (5) from housing. Remove and discard gasket.

(3) Remove twelve self-locking nuts (6). Remove ten self-locking nuts and machine bolts (7) and two self-locking bolts (10). Remove clamp brackets (8). Install jack screws (5/16-24 thread) into three threaded holes (9) in fan drive housing cover (10) and alternately tighten jack screws until cover is separated from fan drive housing and remove cover and clutch assembly. Remove jack screws.

(4) Remove and discard fan drive housing cover preformed packing. Separate housing cover from vertical drive shaft and remove clutch upper ball bearing from housing cover.



1 Locking wire
2 Machine bolt and flat washer
3 Puller screw hole
4 Oil seal housing
5 Oil seal
6 Self-locking nut
7 Bolt, plate and clamp
8 Clamp bracket
9 Threaded hole
10 Self-locking bolt
11 Fan drive housing cover

Figure 2-113. Removing or installing fan drive oil seal and clutch bearing.

b. Installation.

(1) Press ball bearing into fan drive housing cover and install cover on vertical drive shaft. Install new preformed packing on fan drive housing cover.

(2) Install assembled fan drive housing cover (11, fig. 2-113) and clutch assembly on fan drive housing. Position fuel injector tube clamp brackets (8), on fan drive housing cover as shown in figures 2-113 and 2-114, and secure housing cover and brackets with twelve self-locking nuts (6, fig. 2-113). Install associated plates and clamps and secure with ten self-locking nuts and machine bolts (7) and two self-locking bolts (10).

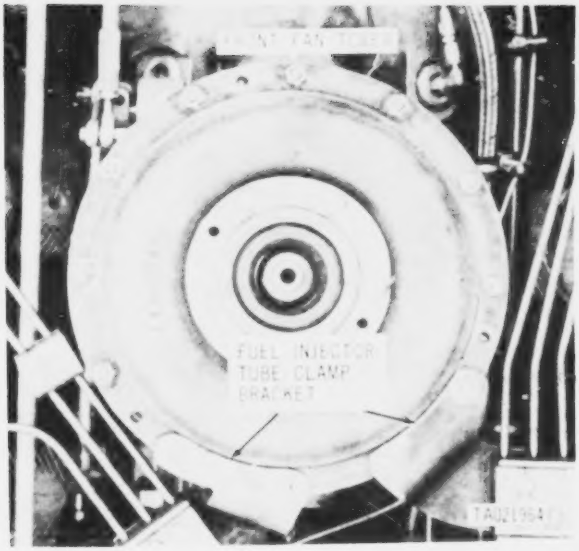

FRONT FAN TOWER
FUEL INJECTOR
TUBE CLAMP
BRACKET
TA021964

Figure 2-114. Front fan tower fuel injection tube clamp bracket location.

(3) Install oil seal (5) in oil seal housing (4) with lip of oil seal toward the bottom of the housing, and the felt toward the top.

(4) Install fan drive oil seal housing (4) using new gasket, on fan drive housing cover and secure with six bolts and flat washers (2). Install locking wire (1).

(5) Install cooling fans and cooling fan vanes (para. 2-21*b*).

2-39. Fuel Injector Tubes

a. Removal.

(1) Remove cooling fan vanes, cooling fans, engine upper covers, and cooling fan shroud. Refer to paragraph 2-21*a*.

(2) Remove fuel injector tube clamps and tubes. Refer to paragraph 2-21*a*.

b. Installation.

(1) Install fuel injector tubes and clamps (para 2-21*b*).

(2) Check for fuel leaks (para 2-21b).

(3) Install cooling fan shroud, engine upper covers, cooling fans and fan vanes (para 2-21*b*).

2-40. Throttle Linkage and Manual Fuel Shut-off Rods

a. Removal.

(1) Remove cooling fan vanes and cooling fans. Refer to paragraph 2-21*a*.

(2) Remove cotter pin and flat washer (fig. 2-115) and disconnect manual fuel shut-off rod assembly. Discard cotter pin. Remove self-locking nut, and machine bolt, and disconnect adjustable rod.

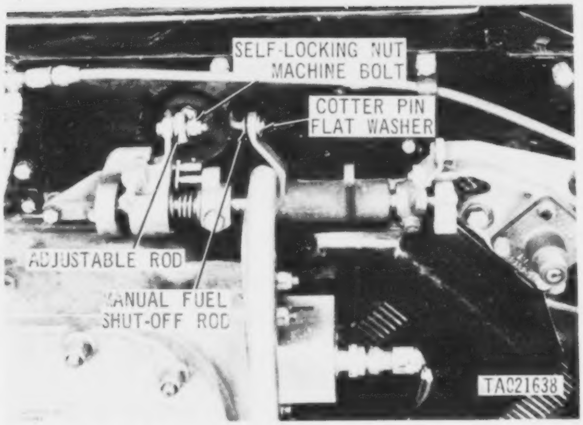

SELF-LOCKING NUT
MACHINE BOLT
COTTER PIN
FLAT WASHER
ADJUSTABLE ROD
MANUAL FUEL
SHUT-OFF ROD
TA021638

Figure 2-115. Disconnecting or connecting manual fuel shut-off rod and adjustable throttle rod.

(3) Remove self-locking nut and machine bolt (fig. 2-116) and remove adjustable throttle rod. Remove two self-locking nuts, machine bolts and one flat washer and remove throttle operating lever rod.

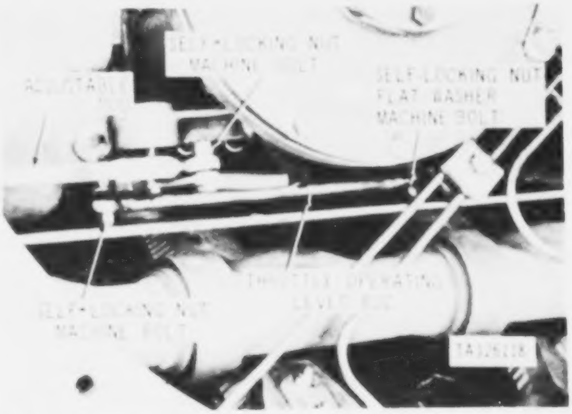

SELF-LOCKING NUT
MACHINE BOLT
ADJUSTABLE
ROD
SELF-LOCKING NUT
FLAT WASHER
MACHINE BOLT
THROTTLE OPERATING
LEVER ROD
SELF-LOCKING NUT
MACHINE BOLT

Figure 2-116. Removing or installing adjustable rod and throttle operating lever rod.

(3.1) Deleted.

Figure 2-116.1. Deleted

(4) Remove cotter pin and flat washer (fig. (2-117) and remove manual fuel shut-off rod. Discard cotter pin.

b. Installation.

(1) Install throttle operating lever rod (fig. 2-116) and secure to fuel injection pump lever with machine bolt, flat washer and self-locking nut. Secure rod to intermediate lever with machine bolt and self-locking nut. Install adjustable rod and secure with self-locking nut and machine bolt. Install manual fuel shut-off rod assembly (fig. 2-117) and secure with flat washer and new cotter pin. Install adjustable rod (fig. 2-115) and secure with self-locking nut and machine bolt. Install manual fuel shut-off rod and secure with flat washer and new cotter pin.

(1.1) Deleted.

(2) Check throttle linkage and manual fuel shutoff rod for free movement. Refer to paragraph 2-21*b*.

(3) Install cooling fans and cooling fan vanes (para 2-21b).

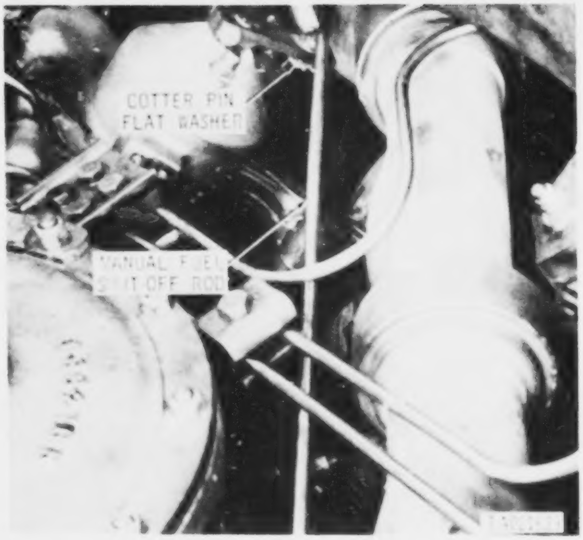


Figure 2-117. Removing or installing manual fuel shut-off rod.

2-40.1. Transmission Control Rod, Model AVDS-1790-2DR Engine

Deleted

Figure 2-117.1. Deleted.

2-41. Fuel Injection Pump Drive Coupling

a. Removal.

(1) Remove cooling fan vanes, cooling fans, engine upper covers and cooling fan shroud. Refer to paragraph 2-21*a*.

(2) Remove fuel injector tube clamps and tubes. Refer to paragraph 2-21*a*.

(3) Disconnect electrical lead, oil inlet hose, fuel inlet hose, fuel return hose, and remove fuel injection pump. Refer to paragraph 2-21*a*.

(5) Remove fuel injection pump coupling sleeve and hub from injection pump. Refer to paragraph 2-21*a*.

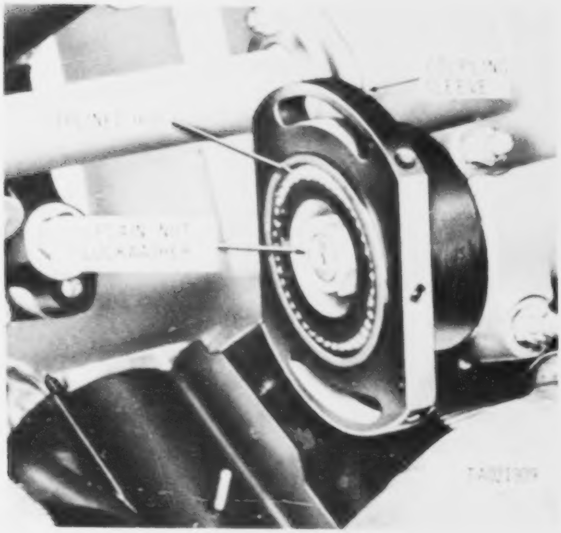


Figure 2-118. Removing or installing fuel injection pump coupling from gearshaft.

(6) Remove plain nut and lockwasher (fig. 2-118) attaching fuel injection pump drive coupling half to fuel injection pump spur gearshaft. Remove coupling sleeve splined hub and key using improvised puller (fig. 2-2).

b. Installation.

(1) Position key, splined hub, and fuel injection pump coupling sleeve (fig. 2-118) on fuel injection pump spur gearshaft and install lockwasher and plain nut. Torque tighten nut to 900 pound-inches.

(2) Install injection pump coupling on fuel injection pump (para 2-21*b*).

(3) Set fuel injection pump and engine timing, and install fuel injection pump on engine (para 2-21*b*).

(4) Install fuel injector tubes, clamps and check for fuel leaks (para 2-21*b*).

(5) Install cooling fan shroud, engine upper covers, cooling fans and cooling fan vanes (para 2-21*b*).

2-42. Manifold Heater or Ignition Unit

WARNING

The ignition units on this engine are capable of producing extremely high voltage. The output of this ignition system is sufficient to cause a dangerous electrical shock. Never touch any uncovered or live connections.

NOTE

The heater and ignition unit on each side of the engine are removed in the same manner. For instructional purposes removal of the left heater and ignition unit is described in the following instructions.

a. Removal.

(1) Ignition Unit.

(a) Disconnect manifold heater electrical lead (1, fig 2-119) and wiring harness electrical lead (2) from ignition unit (4).

(b) Loosen two machine screws (3) and remove ignition unit (4) from clamps.

(2) Manifold Heater.

(a) Disconnect electrical lead (1, fig. 2-119) at spark plug. Disconnect manifold air heater fuel inlet hose from elbow (5) and disconnect manifold air heater fuel return tube (6).

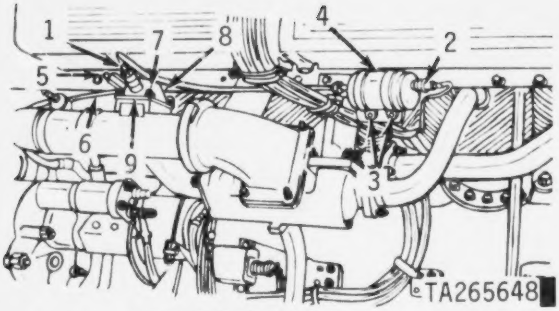
(b) Remove four self-locking nuts and flat washers (7) and remove manifold heater assembly (8). Remove and discard gasket (9).

b. Installation.

(1) Manifold Heater.

(a) Install manifold heater (8, fig. 2-119) on heater tube using new gasket (9), and secure to heater tube with four self-locking nuts and flat washers (7).

(b) Connect manifold air heater fuel return



1 Electrical lead
2 Wiring harness electrical lead
3 Machine screw
4 Ignition unit
5 Elbow
6 Fuel return tube
7 Nut and washer
8 Manifold heater
9 Gasket

Figure 2-119. Removing or installing manifold heater or ignition unit.

tube (6) and manifold air heater fuel inlet hose to elbow (5). Connect electrical lead (1) at spark plug.

(2) Ignition Unit.

(a) Install ignition unit (4) in clamps and tighten two machine screws and self-locking nuts (3).

(b) Connect manifold heater electrical lead (1) and wiring harness electrical lead (2).

2-43. Manifold Heater Fuel Filter or Solenoid Valves

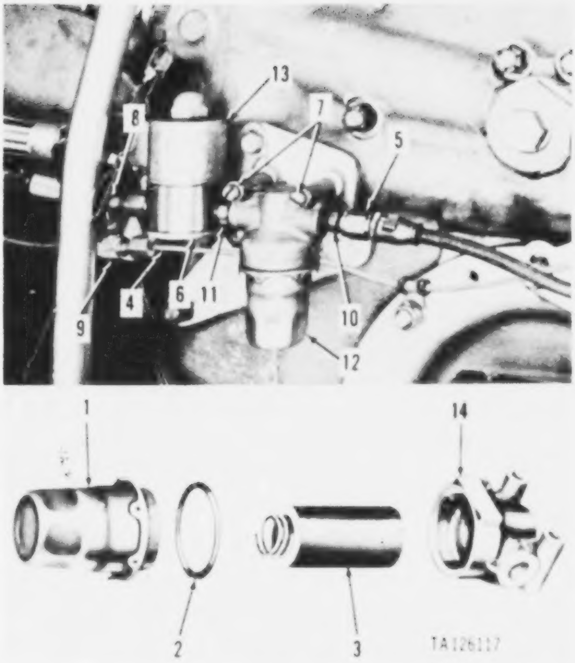
a. Removal.

(1) Cut locking wire and remove sediment bowl (1, fig. 2-120). Remove and discard preformed packing (2) and element (3). Install new element, new preformed packing and sediment bowl. Install locking wire.

(2) Disconnect solenoid valve electrical lead. Disconnect manifold heater tubes (4). Disconnect fuel filter inlet tube (5). Remove two assembled washer bolts (6) and two screws, lockwashers and flat washers (7) and remove fuel filter and solenoid valve as an assembly. Remove fuel solenoid valve outlet elbow (8) and tee (9). Remove fuel filter inlet connector (10) and nipple (11) from solenoid valve and/or filter.

(3) Disconnect fuel solenoid outlet tube (1, fig. 2-121) and fuel solenoid inlet tubes (2). Remove two assembled washer bolts (3) and remove solenoid valve (4) and associated fittings from bracket (5).

(4) Remove the fuel solenoid inlet coupling, elbow and tee (6) as an assembly. Remove the fuel solenoid outlet elbow, check valve and elbow (7) as an assembly.



1 Filter bowl
2 Preformed packing
3 Filter element
4 Manifold heater tube
5 Fuel filter inlet tube
6 Assembled washer bolt
7 Screws and washers
8 Outlet elbow
9 Outlet tee
10 Fuel filter inlet connector
11 Nipple
12 Manifold heater fuel filter
13 Manifold heater fuel inlet solenoid valve
14 Filter head

Figure 2-120. Removing or installing manifold heater fuel inlet solenoid valve or fuel filterfilter element.

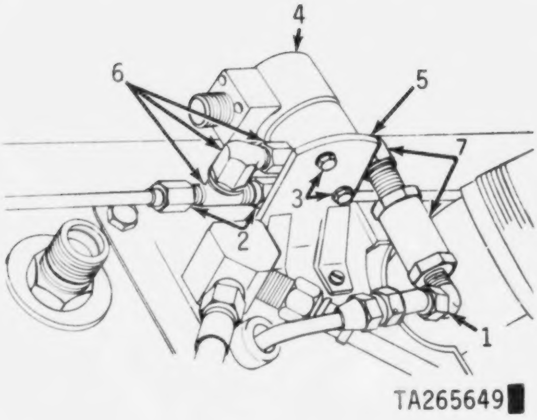
b. Installation.

NOTE

If solenoid valves are equipped with felt line filters in the inlet and outlet openings, they must be removed and discarded. Felt line filters are not required.

(1) Install nipple (11, fig. 2-120) in fuel solenoid "IN" opening and/or filter "OUT" opening. Install fuel filter inlet connector (10) and solenoid outlet elbow (8) and tee (9). Install assembled fuel filter (12) and assembled solenoid valve (13) on brackets and secure with two screws, lockwashers and flat washers (7) and two assembled washer bolts (6). Connect fuel filter inlet tube (5) and manifold heater tubes (4).

(2) Install elbow, check valve and elbow (7, fig. 2-121) in solenoid valve "OUT" opening. Install coupling, elbow and tee (6) in solenoid valve "IN" opening. Install assembled fuel solenoid valve (4) and secure to bracket (5) with two assembled washer bolts (3) and connect fuel solenoid inlet tubes (2) and solenoid outlet tube (1). Connect electrical lead.



1 Outlet tube
2 Inlet tube
3 Assembled washer bolt
4 Solenoid valve
5 Bracket
6 Coupling, elbow and tee
7 Fuel solenoid elbow, check valve and elbow

Figure 2-121. Removing or installing manifold heater fuel return solenoid valve.

NOTE

If the fuel return check valve is removed, it must be installed with the arrow pointing downward.

2-44. Fuel/Water Separator Filter Automatic Drain System or Solenoid Valve

a. Removal.

(1) Open drain cock (fig. 2-62) and bleeder valve (fig. 2-122) and drain fuel into a suitable container.

(2) Loosen but do not remove two lower capscrews and two upper capscrews and pull fuel/water separator away from mounting bracket. Remove one capscrew, lockwasher and cushioned clamp and remove two water level probes from the filter.

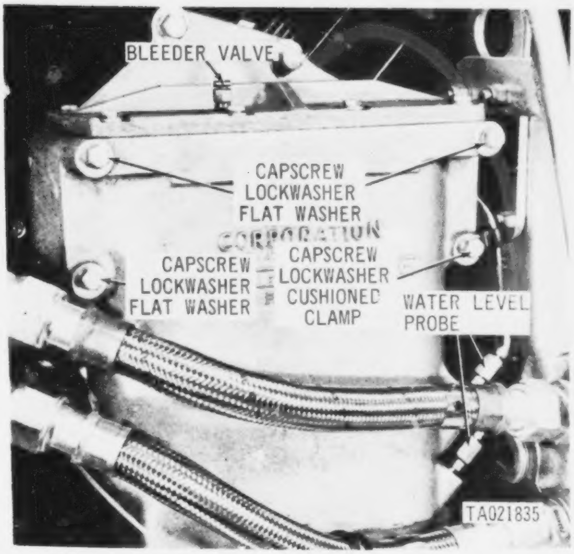


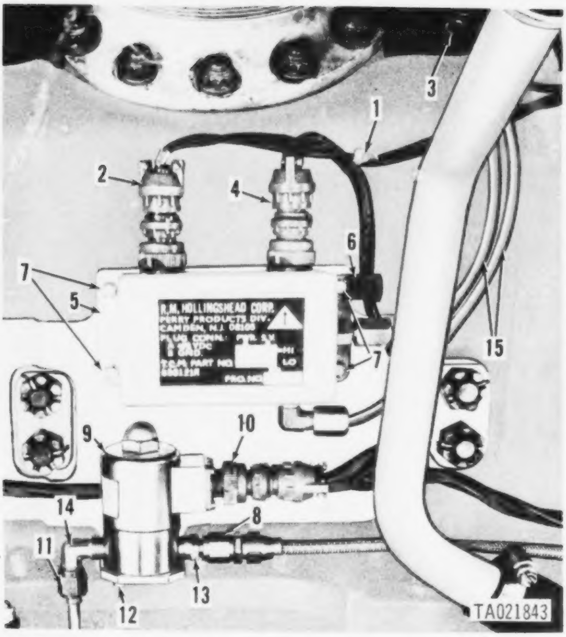
Figure 2-122. Removing or installing water level probes.

NOTE

Model AVDS-1790-2DR is not equipped with an engine wiring harness.

(3) Cut and discard tie-wrap (1, fig. 2-123) and disconnect wiring harness electrical lead (2). Remove one machine screw and cushioned clamp (3). Disconnect wiring harness lead (4) from control module (5). Remove assembled washer bolt and cushioned clamp (6). Remove three assembled washer bolts (7) and remove control module.

(4) Disconnect filter drain hose (8) from solenoid valve (9). Disconnect wiring harness lead (10) from solenoid valve. Disconnect solenoid valve drain tube (11). Remove two assembled washer bolts (12) and remove solenoid valve and fittings from bracket. Remove nipple (13) from solenoid valve "IN" opening, and elbow (14) from "OUT" opening.



1 Tie-wrap
2 Wiring harness electrical lead
3 Machine screw and clamp
4 Wiring harness lead
5 Control module
6 Assembled washer bolt and clamp
7 Assembled washer bolt
8 Filter drain hose
9 Solenoid valve
10 Wiring harness lead
11 Drain tube
12 Assembled washer bolt
13 Nipple
14 Elbow
15 Probe lead wires

Figure 2-123. Removing or installing fuel/water separator filter automatic drain control module or solenoid valve.

b. Installation.

(1) Install control module (5, fig. 2-123) and secure with three assembled washer bolts (7) and assembled washer bolt and cushioned clamp (6). Connect wiring harness lead (4) to control module. Install cushioned clamp and machine screw (3) securing probe lead wires (15) to cylinder deflector.

(2) Install nipple (13) in solenoid "IN" opening and elbow (14) in "OUT" opening. Install the solenoid valve on mounting bracket and secure with two assembled washer bolts (12). Install solenoid valve drain tube (11) and connect wiring harness lead (10) and filter drain hose (8). Connect wiring harness electrical lead (2) and install new tie-wrap (1).

(3) Install two water level probes (fig. 2-122) making sure that the upper probe, identified by red shrink tube, is in the upper boss on the fuel/water separator filter. Install cushioned clamp, lockwasher and capscrew on fuel filter. Tighten two lower and two upper capscrews.

(4) Close drain cock (fig. 2-62). Purge fuel system and close bleeder valve (fig. 2-122).

2-45. Starter Low Voltage Protective Module—Early Engines

a. Removal. Disconnect wiring harness. Remove two capscrews, insulator washers and self-locking nuts (fig. 2-124) and remove module from mounting bracket.

b. Installation. Install module (fig. 2-124) on mounting bracket and secure with two capscrews, insulator washers and self-locking nuts. Connect wiring harness.

2-45.1. Starter Low Voltage Protective Module—Late Engines

a. Removal. Disconnect wiring harness from starter low voltage protective module (fig. 2-124.1). Remove two capscrews and lockwashers and remove wiring harness ground lead and module.

b. Installation. Position module (fig. 2-124.1) on mounting bracket and secure module and ground lead with two capscrews and lockwashers. Connect wiring harness.

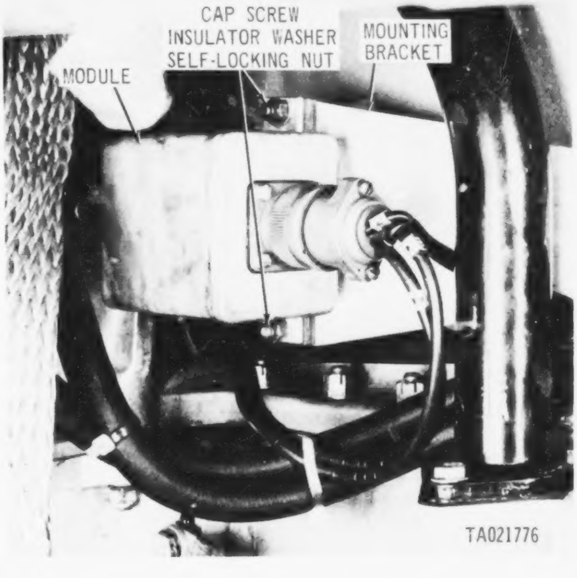


Figure 2-124. Removing or installing starter low voltage protective module.

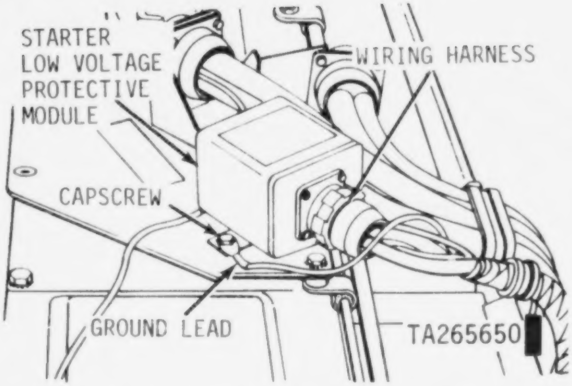

STARTER
LOW VOLTAGE
PROTECTIVE
MODULE
WIRING HARNESS
CAPSCREW
GROUND LEAD
TA265650

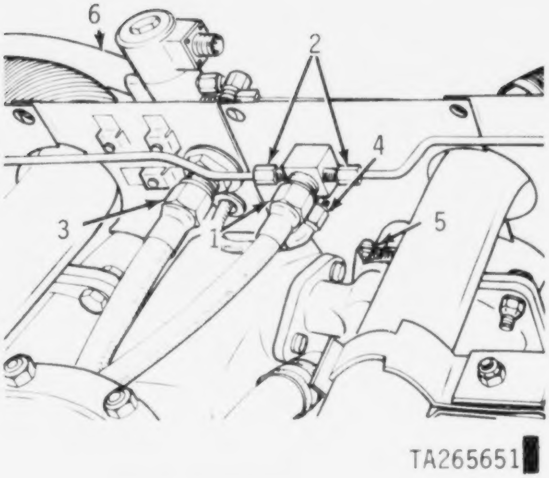
Figure 2-124.1. Removing or installing starter low voltage protective module – late engines.

2-46. Exhaust Manifolds or Elbows

a. Removal.

(1) Remove cooling fan vanes, cooling fans, cooling fan shroud, fuel injection tube clamps and fuel injection tubes. Refer to paragraph 2-21*a*.

(2) Disconnect fuel return hose (1, fig. 2-125) and fuel return tube (2). Disconnect turbosupercharger oil hose (3) and manifold heater fuel return hose (4). Remove crankcase breather tube hose and clamp (5) and breather tube (6).


6
2
4
3
1
5
TA265651

1 Fuel return hose
2 Fuel return tubes
3 Turbosupercharger oil hose
4 Manifold heater fuel return hose
5 Hose clamp
6 Crankcase breather tube

Figure 2-125. Disconnecting or connecting fuel and oil lines.

(2.1) On Models AVDS-1790-2C and AVDS-1790-2D, remove two capscrews, self-locking nuts, retaining straps, and clamp pads (fig. 2-125.1). Disconnect two smoke generating tube nuts from tee. Loosen tube nuts and remove tube adapters from exhaust manifolds. Remove and discard smoke generating tubes.

(2.2) On Model AVDS-1790-2DR, remove two capscrews and self locking nuts securing two loop clamps (fig. 2-125.2) to rear shrouds. Disconnect two smoke generating tube nuts from tee. Loosen tube nuts and remove tube adapters from exhaust manifold. Remove smoke generating tubes.

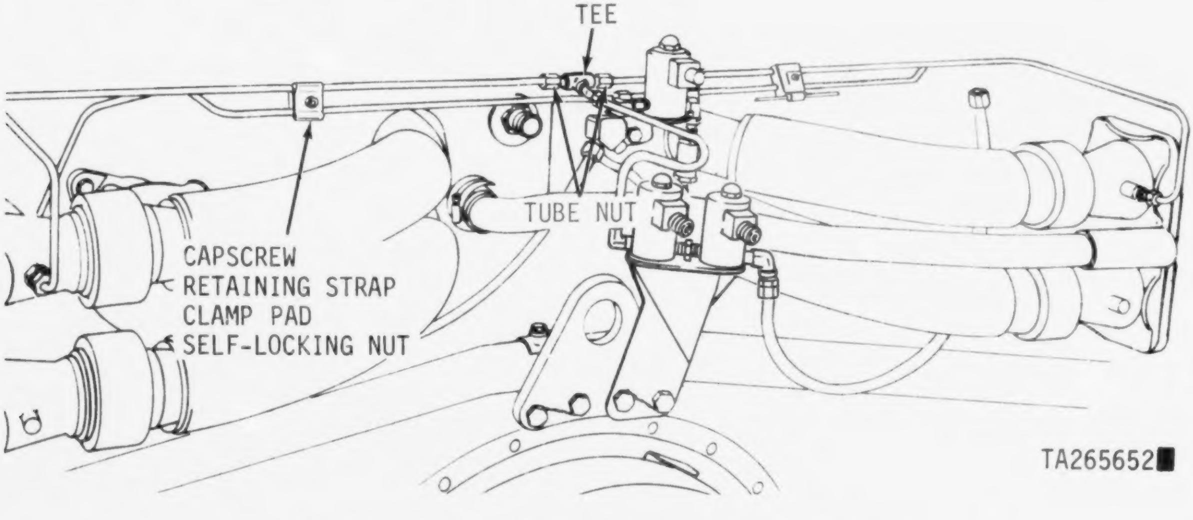

TEE
TUBE NUT
CAPSCREW
RETAINING STRAP
CLAMP PAD
SELF-LOCKING NUT
TA265652

Figure 2-125.1. Removing or installing smoke generating system fuel tubes, model AVDS-1790-2C and AVDS-1790-2D engines.

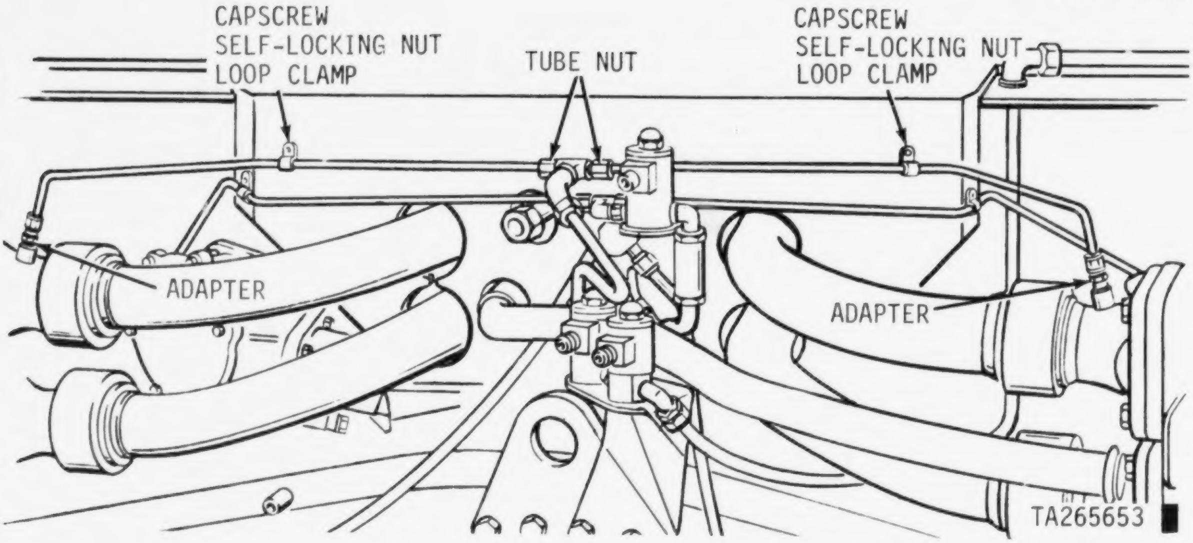
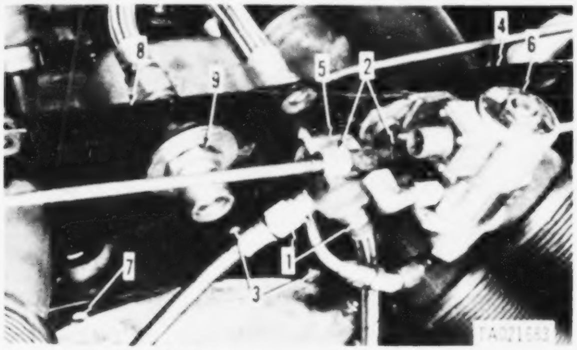


Figure 2-125.2. Removing or installing smoke generating system fuel tubes, model AVDS-1790-2DR engine.

(3) Disconnect right and left turbosupercharger oil hoses (1, fig. 2-126). Disconnect manifold heater fuel return tubes (2).

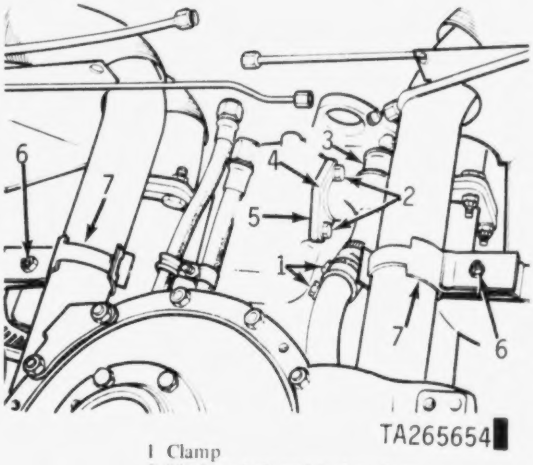
(4) Remove two machine screws and lockwashers (3) and remove left rear center shroud (4), bulkhead adapter elbow (5), and solenoid valve assembly (6) as a unit. Remove one machine screw and lockwasher (7) and remove right rear center shroud (8) and tube cross (9) as a unit.



1 Oil hose
2 Heater fuel return tube
3 Machine screw and lockwasher
4 Left rear center shroud
5 Bulkhead adapter elbow
6 Solenoid valve assembly
7 Screw and washer
8 Right rear center shroud
9 Tube cross

Figure 2-126. Removing or installing left and right rear center shrouds.

(5) Loosen two breather tube clamps (1, fig. 2-127) and remove two bolts and lockwashers (2) and remove tube tee (3). Remove restrictor (4). Remove and discard two gaskets (5). Remove two self-locking nuts and bolts (6) and remove two sets of retaining straps (7).



1 Clamp
2 Machine bolt and lockwasher
3 Tube tee
4 Restrictor
5 Gasket
6 Self-locking nut and machine bolt
7 Retaining strap

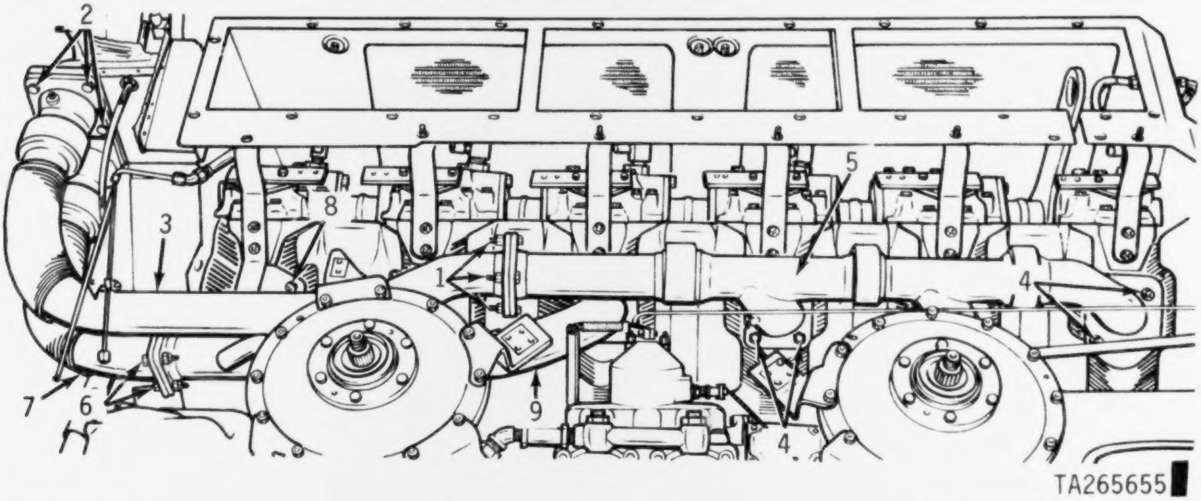
Figure 2-127. Removing or installing crankcase breather tube tee and restrictor.

NOTE

The exhaust manifolds and exhaust manifold elbows on each side of the engine are removed in the same manner. For instructional purposes removal of the right hand manifolds and elbows are described in the following instructions.

(6) Remove four self-locking nuts, flat washers and bolts (1, fig. 2-128), and four self-locking nuts, flat washers and machine bolts (2). Remove exhaust elbow (3), remove and discard two gaskets. Remove twelve self-locking nuts and flat washers (4), and remove exhaust manifold (5). Remove and discard three gaskets.

(7) Remove four self-locking nuts, flat washers and machine bolts (6). Remove four self-locking nuts, flat washers, and machine bolts attaching exhaust elbow (7) to turbosupercharger. Remove exhaust elbow and remove and discard two gaskets. Remove twelve self-locking nuts and flat washers (8) and remove exhaust manifold (9). Remove and discard three gaskets.



1 Nut, washer and bolt
2 Nut, washer and bolt
3 Exhaust elbow cylinder 1R, 2R, 3R
4 Self-locking nut and flat washer
5 Exhaust manifold cylinder 1R, 2R, 3R
6 Nut, washer and bolt
7 Exhaust elbow cylinder 4R, 5R, 6R
8 Self-locking nut and flat washer
9 Exhaust manifold cylinder 4R, 5R, 6R

Figure 2-128. Removing or installing exhaust manifolds and elbows.

b. Installation.

(1) Install exhaust manifold (9, fig. 2-128) on cylinder Nos. 4R, 5R, 6R using new gaskets and secure to cylinders with twelve self-locking nuts and flat washers (8). Install exhaust elbow (7) using new gaskets, and secure to the exhaust manifold with four self-locking nuts, flat washers and bolts (6) and to turbosupercharger with four self-locking nuts, flat washers and bolts.

(2) Install exhaust manifold (5) on cylinders Nos. 1R, 2R, 3R using new gaskets and secure to cylinders with twelve self-locking nuts and flat washers (4). Install exhaust elbow (3) using new gaskets and secure to the exhaust manifold with four self-locking nuts, flat washers and machine bolts (1) and to turbosupercharger with four self-locking nuts, flat washers and machine bolts (2).

(3) Deleted

(4) Install two sets of retaining straps (7, fig 2-127) and secure to oil cooler frame support with two machine bolts and self-locking nuts (6). Install gasket (5), restrictor (4), gasket (5) and tube tee (3)(in that order) on rear fan drive housing. Install two bolts and lockwashers (2) securing parts to housing. Position hose between breather tube and tube tee and tighten two hose clamps (1).

(5) Install right rear center shroud (8, fig. 2-126) and tube cross (9) as a unit, and secure with one machine screw and lockwasher (7). Install left rear center shroud (4), bulkhead adapter elbow (5) and solenoid valve assembly (6) as a unit, and secure with two machine screws and lockwashers (3).

(6) Connect fuel return tubes (2) and right and left turbosupercharger oil hoses (1).

(7) Position crankcase breather tube (6, fig. 2-125) and hose through right rear center shroud and on breather tube tee and tighten hose clamp (5). Connect manifold heater fuel return hose (4) and turbosupercharger oil hose (3). Connect fuel return tubes (2) and fuel return hose (1).

(7.1) On Models AVDS-1790-2C and AVDS-1790-2D, install two new smoke generating tubes and connect tube nuts to tee (fig. 2-125.1). Secure tube adapters to exhaust manifolds and tighten tube nuts. Secure two clamp pads and retaining straps with two capscrews and self-locking nuts.

(7.2) On Model AVDS-1790-2DR, install two new smoke generating tubes and connect tube nuts to tee (fig. 2-125.2). Secure tube adapters to exhaust manifolds and tighten tube nuts. Secure tubes to rear shrouds with two capscrews, self-locking nuts and loop clamps.

(8) Install fuel injector tubes, tube clamps, cooling fan shroud, cooling fans and cooling fan vanes (par. 2-21*b*).

2-47. Fuel Backflow Valve (Models AVDS-1790-2C and AVDS-1790-2D)

a. Removal.

(1) Disconnect fuel inlet hose (1, fig. 2-129) and drain fuel into a suitable container. Disconnect manifold heater fuel line (2) and fuel pump fuel inlet tube (3). Remove two screws and lockwashers (4), and remove backflow valve (5) from mounting bracket.

(2) Remove and retain for installation in replacement backflow valve the fuel pump tube adapter (6) and fuel inlet hose adapter (7). Remove and retain as a unit the purge pump and fuel heater tube tee (8), reducer (9), filter (10) and elbow (11).

NOTE

Elbow (11, fig. 2-129) is required on Model AVDS-1790-2C only.

b. Installation.

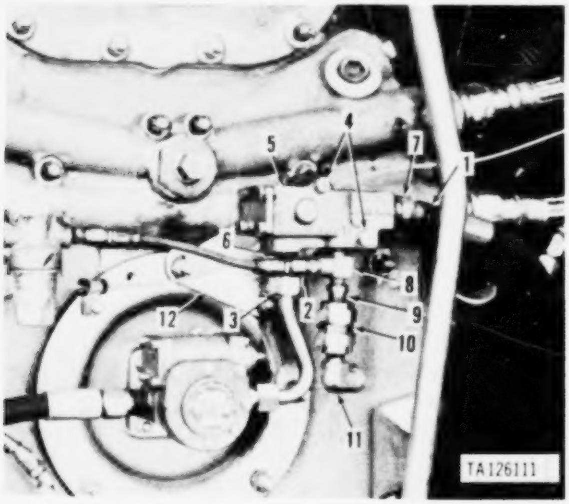
(1) Install as a unit, the purge pump and fuel heater tube tee, (8, fig. 2-129), reducer (9), filter (10) and elbow (11). Install fuel inlet hose adapter (7) and fuel pump tube adapter (6).

(2) Position backflow valve (5) on mounting bracket (12) and fuel pump inlet tube (3) and secure backflow valve with two screws, lockwashers, one flat washer and one clip (4). Connect fuel pump fuel inlet tube (3), manifold heater fuel line (2) and fuel inlet hose (1).

2-47.1. Fuel Backflow Valve (Model AVDS-1790-2DR)

a. Removal.

(1) Disconnect fuel inlet hose (1, fig. 2-129.1) and drain fuel into a suitable container. Disconnect manifold heater fuel line (2) and backflow valve outlet hose (3). Remove two screws, lockwashers and flat washers (4) and remove backflow valve from mounting bracket.



1 Inlet hose
2 Manifold heater fuel line
3 Fuel inlet tube
4 Screw and washer
5 Backflow valve
6 Tube adapter
7 Inlet hose adapter
8 Tee
9 Reducer
10 Filter
11 Elbow
12 Mounting bracket

Figure 2-129. Removing or installing fuel backflow valve, model AVDS-1790-2C and AVDS-1790-2D engines.

(2) Remove and retain for installation in the replacement backflow valve, the fuel pump hose adapter (5) and fuel inlet hose adapter (6). Remove and retain the purge pump and fuel heater tube tee (7), and bushing (8).

b. Installation.

(1) Install bushing (8, fig. 2-129.1), and tee (7) on new backflow valve. Install fuel inlet hose adapter (6) and hose adapter (5) in backflow valve.

(2) Install backflow valve on mounting bracket and secure with two flat washers, lockwashers and screws (4). Connect check valve outlet hose (3) and manifold heater fuel line (2). Connect fuel inlet hose (1).

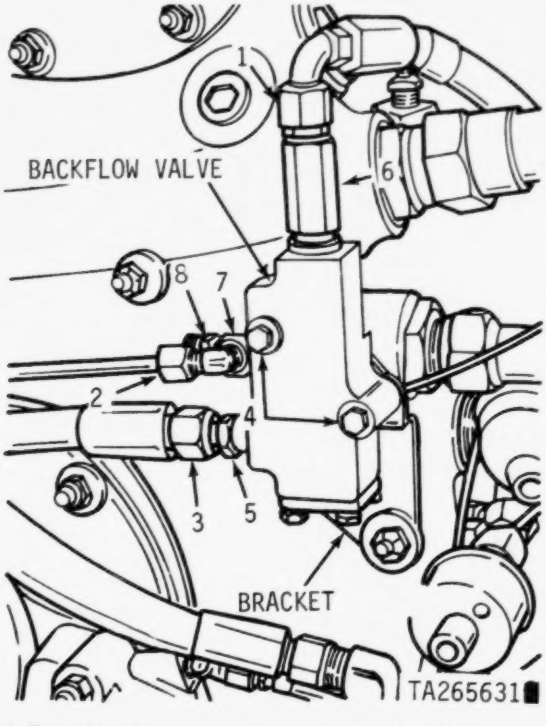
2-48. Replacement and/or Repair of Fuel Injector Nozzle and Holder Assembly.

a. Removal.

(1) Remove cooling fan vanes, cooling fans, fan shroud, and engine upper covers. Refer to paragraph 2-21*a*.

(2)Remove fuel injector lines and fuel injector nozzle and holder assemblies. Refer to paragraph 2-21*a* and 2-30*a*.

(3) The fuel injector nozzle and holder assemblies are generally removed while troubleshooting the fuel system, particularly when a fuel injection pump has failed. The nozzles should be tested on a nozzle tester for opening pressure, spray pattern, leakage and nozzle chatter before reinstalling in engine. Check the nozzle retaining



1 Fuel inlet hose
2 Manifold heater fuel line
3 Backflow valve outlet hose
4 Screw, lockwasher and flat washer
5 Hose adapter
6 Hose adapter
7 Tube tee
8 Bushing

Figure 2-129.1. Removing or installing fuel backflow valve, model AVDS-1790-2DR engine.

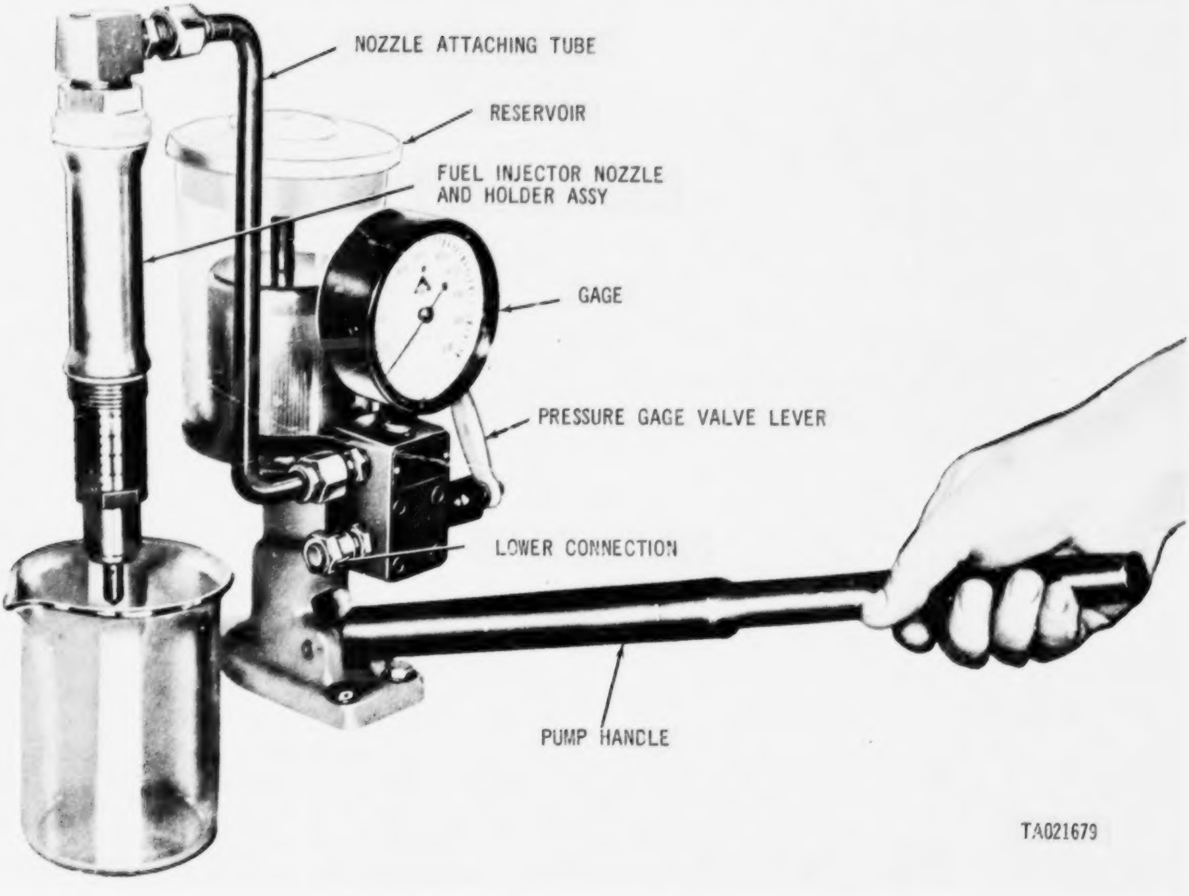


Figure 2-132. Testing fuel injector nozzle and holder assembly.

(5) *Check Nozzle Chatter.* The chatter test requires that one stroke of the tester handle takes approximately two seconds, with pressure gage valve closed. Chatter must be distinct and regular. A sharp pitch sound is not mandatory, and an occasional skip or variation in chatter pitch is acceptable. When nozzle chatter is not satisfactory, and does not improve with continued operation of the tester, the nozzle must be replaced.

c. Disassembly.

CAUTION

It is of utmost importance that the work area be clean and free from dust. Proper repair of nozzles is dependent *primarily* on cleanliness.

NOTE

Preformed packing (7 and 7.1 fig. 2-133) and gasket (10) were removed and discarded in paragraph 2-30*a*, (6).

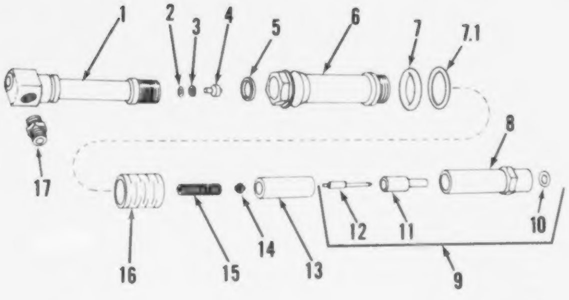
(1) Remove nozzle tube connector (17, fig. 2-133), capnut (8), retainer spring (16), fuel injector nozzle assembly (9), with nozzle body (11) and nozzle valve (12), nozzle spacer (13) and retainer (6).

(2) Remove lower spring seat (14), nozzle adjusting spring (15), upper spring seat (4), shims (3) and seat spacer (2) from nozzle body (1). Remove and discard preformed packing (5). Note the number of shims (3) removed.

(3) Remove nozzle valve (12) from body (11). It may be necessary to soak the nozzle assembly in carbon removing solvent to aid in disassembly.

NOTE

The nozzle body and nozzle valve were fitted individually during manufacture to form a mated assembly and parts are not interchangeable between nozzles. Care must be taken during the cleaning, inspection and repair operations to keep these parts together.



TA265656

1	Nozzle body
2	Seat spacer
3	Shim
4	Upper spring seat
5	Preformed packing
6	Nozzle retainer
7	Preformed packing
7.1	Preformed packing
8	Capnut
9	Nozzle assembly
10	Flat washer (gasket)
11	Nozzle body
12	Nozzle valve
13	Nozzle spacer
14	Lower spring seat
15	Nozzle spring
16	Retainer spring
17	Tube connector

Figure 2-133. Fuel injector nozzle and holder assembly — exploded view.

d. Cleaning.

NOTE

Do not use sharp tools, wire brushes or abrasive materials to clean the nozzle or nozzle body.

(1) *Clean Fuel Injector Nozzle Assembly.* Soak nozzle body in carbon removing solvent to remove major carbon deposits. Remaining carbon deposits should be removed using a soft cloth or felt pad and mutton tallow. A piece of soft wood, soaked in oil may also be used as a carbon remover.

(2) *Clean Nozzle Spray Orifices.* Remove carbon from the orifices of the nozzle body by soaking nozzle body in a carbon removing solvent only. Do not clean orifices with cleaning wire as this method will distort nozzle orifices and also may block opening due to wire breakage.

(3) *Clean Fuel Injector Holder and Associated Parts.* Clean all parts thoroughly. Be sure hands are kept free from accumulation of grease which will cause collection of dust and grit on parts. Cover or wrap all parts after cleaning to protect them from dirt accumulation.

e. Inspection.

(1) *Inspect Nozzle Body and Valve.* Inspect seat of nozzle valve (12, fig. 2-133) for evidence of wear, distortion of the valve seat due to pounding, discoloration due to overheating, and pitting. Inspect the valve stem for scratches and discoloration. Check fit of valve in nozzle body (11) by lifting the valve about one-third of its length out of the body. The valve should slide back to its seat without aid when the assembly is held at a 45 degree angle. Inspect the eight spray orifices in the nozzle body tip and the drilled passage in the body for freedom of obstructions. Inspect lapped sealing surfaces of valve body for cracks, scratches, discoloration, wear, pitting and evidence of pounding.

(2) *Inspect Nozzle Spacer.* Inspect the lapped sealing surfaces on the ends of the nozzle spacer (13) for scratches, discoloration, and cracks. Inspect the area around the center hole on the nozzle end for evidence of wear and pounding by the valve nozzle body. Maximum allowable depth of wear of pounding at this area is 0.003-inch. Inspect drilled passages in spacer for obstructions.

(3) *Inspect Nozzle and Retainer Springs, Spring Seats and Shims.* Inspect the nozzle spring (15) for cracks and evidence of wear. Inspect retainer spring (16) for cracks, and for evidence of discoloration due to excessive heat. Free length of retainer spring must be 1.403 to 1.409-inch. Inspect upper and lower spring seats (4) and (14), shims (3) and seat spacer (2) for cracks, scratches, and evidence of pounding.

(4) *Inspect Nozzle Body and Retainer.* Inspect the nozzle body (1) and nozzle retainer (6) for cracks, burrs, nicks, and raised metal. Inspect sealing surfaces for scratches and discoloration. Inspect threaded areas and tapped openings for stripped or damaged threads.

(5) *Inspect Nozzle Capnut and Tube Connector.* Inspect the nozzle capnut (8) and tube connector (17) for nicks, burrs, raised metal surfaces, and cracks. Inspect threaded area inside capnut for stripped or damaged threads. Inspect the gasket area on end of capnut for deep scratches.

f. Repair.

(1) Replace nozzle assembly (9) when body seat or valve seat is badly worn, pounded, or pitted, or when nozzle body orifices are clogged. Replace nozzle assembly when lapped sealing surfaces are nicked, scratched or cracked.

(2) Repair of the remaining nozzle components is limited to cleaning up threads on the nozzle body (1), nozzle retainer (6) and capnut (8). It is not practical to attempt repairs to any of the remaining parts. If inspection revealed damage to any of the remaining parts, replace the complete nozzle and holder assembly.

g. Assembly.

NOTE

During assembly, the addition or removal of spring adjusting shims (to obtain the correct gage pressure reading on the nozzle tester) may require various shim combinations available in shim set 5702674. Although each nozzle assembly pressure reading may vary, experience will indicate the approximate shim(s) thickness required to make up pressure differences. The nozzle assembly must be completely assembled, torque tightened and checked again on the nozzle tester to assure proper spacer combination and pressure reading. This procedure may have to be repeated several times before achieving a satisfactory reading.

(1) Install nozzle valve (12, fig. 2-133) in nozzle body (11). Install a new preformed packing (5) on nozzle body (1). Install upper spring seat (4), shim(s), and seat spacer (2) on one end of nozzle spring (15). Install lower spring seat (14) on other end of spring (15) and install assembled spring (seats, shims and spacers) in nozzle body (1). Install nozzle spacer (13), nozzle assembly (9), nozzle retainer (6) and retainer spring (16). Install capnut (8). Center nozzle body in capnut opening and torque tighten to 65 pound-feet. Install tube connector (17).

(2) Test assembled fuel injector nozzle and holder assembly as outlined in Testing.

h. Installation.

(1) Install fuel injector nozzle and holder assemblies, and fuel injector tubes (para 2-30b and 2-21b).

(2) Install cooling fan shroud, engine upper covers, cooling fans and cooling fan vanes (para 2-21b).

2-49. Engine Electrical Wiring Harness, Generator Cable or Starter Cables

NOTE

This paragraph contains instructions for the complete removal or installation of the engine electrical wiring harness, generator cable, starter cables and associated brackets and clamps. To remove any one cable or harness individually, the procedure is similar except for the removal of the engine disconnect cable connectors from the mounting brackets (fig. 2-144) and (fig. 2-137) by removing four machine screws, lockwashers and hexagon nuts.

a. Model AVDS-1790-2C.

(1) *Removal*

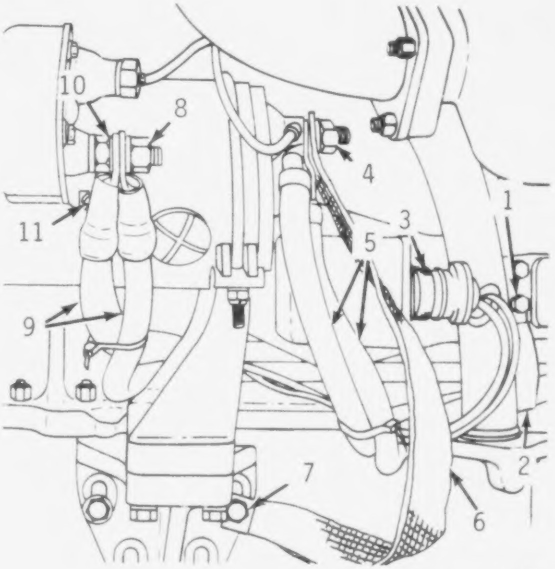
(*a*) Remove capscrew and lockwasher (1, fig. 2-134) and remove starter cable loop clamp (2). Remove starter low voltage protective module cable connector (3). Remove hexagon nut and lockwasher (4) and disconnect two starter ground cables (5) and ground strap (6). Install hexagon nut and lockwasher on starter terminal. Remove capscrew and two flat washers (7) and remove ground strap.

NOTE

Model AVDS-1790-2C engines have two ground straps (6, fig. 2-134).

(*b*) Remove hexagon nut and lockwasher (8) and disconnect two starter cables (9) and starter low voltage protective module cable terminal lug (10). Install hexagon nut and lockwasher on battery terminal.

(*c*) Remove machine screw (11) and disconnect starter low voltage protective module cable terminal lug.



1 Capscrew and lockwasher
2 Clamp
3 Electrical cable connector
4 Hexagon nut and lockwasher
5 Starter cable
6 Ground strap
7 Capscrew and flat washer
8 Hexagon nut and lockwasher
9 Starter cable
10 Terminal lug
11 Machine screw

Figure 2-134. Removing or installing starter electrical cable.

(*d*) Remove self-locking nut and remove starter cable loop clamp (fig. 2-135). Remove capscrew and lockwasher and remove starter cable loop clamp. Remove capscrew and lockwasher and remove wiring harness loop clamp.

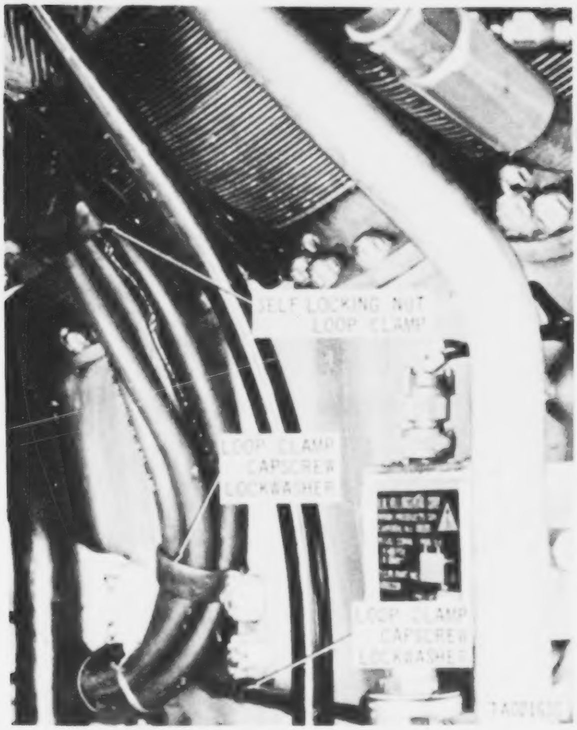

SELF LOCKING NUT
LOOP CLAMP
LOOP CLAMP
CAPSCREW
LOCKWASHER
LOOP CLAMP
CAPSCREW
LOCKWASHER

Figure 2-135. Removing or installing starter cable loop clamps.

(*e*) Remove six capscrews and lock washers (fig. 2-136) and remove three retaining straps. Remove manifold preheat cable connector. Remove two capscrews and lock nuts and remove starter cable bracket assembly.

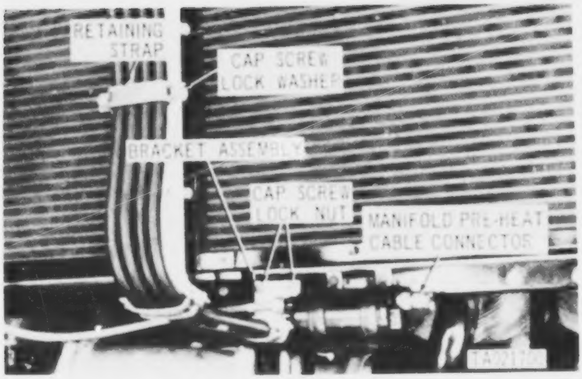

RETAINING STRAP
CAP SCREW
LOCK WASHER
BRACKET ASSEMBLY
CAP SCREW
LOCK NUT
MANIFOLD PRE-HEAT
CABLE CONNECTOR

Figure 2-136. Removing or installing starter cable bracket assembly.

(*f*) On early engines remove four capscrews and lockwashers (fig. 2-137) and disconnect starter cable mounting bracket. Remove two capscrews and lockwashers and remove retaining strap.

(*f.1*) On late engines, remove two assembled washer bolts and loop clamps (fig. 2-136.1) securing smoke generating system electrical lead to left rear upper cover. Remove one assembled washer bolt and loop clamp securing lead to side of oil cooler support frame. Remove one self-locking nut (fig. 2-136.2) and remove loop clamp. Disconnect two electrical connectors from solenoid valves. Remove capscrew and lockwasher securing ground lead to bracket.

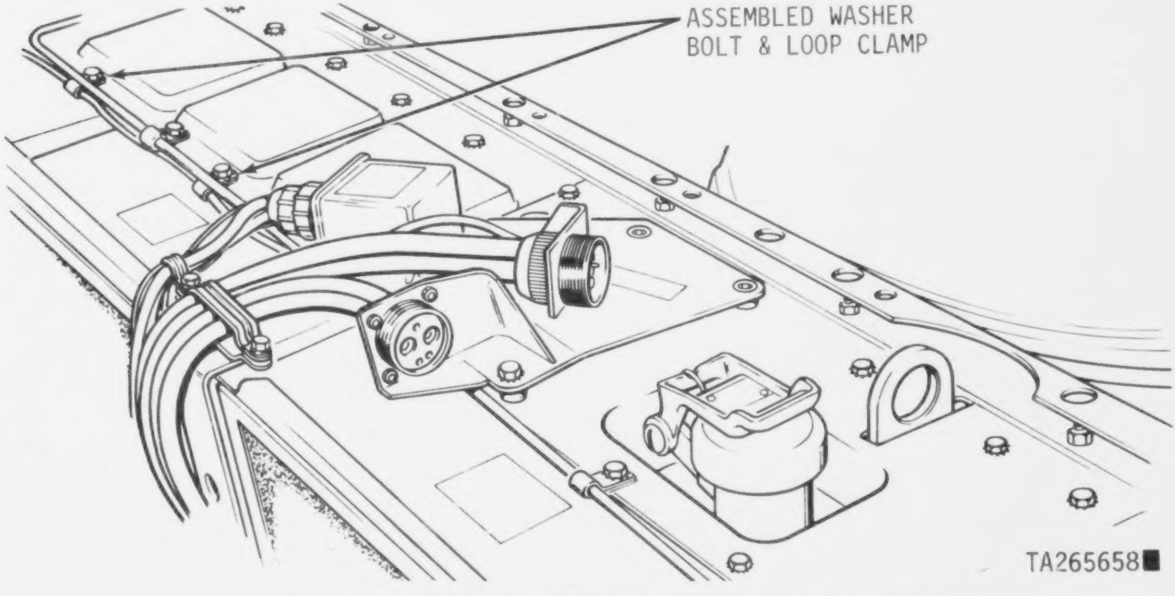

ASSEMBLED WASHER
BOLT & LOOP CLAMP
TA265658

Figure 2-136.1. Removing or installing smoke generating system electrical lead.

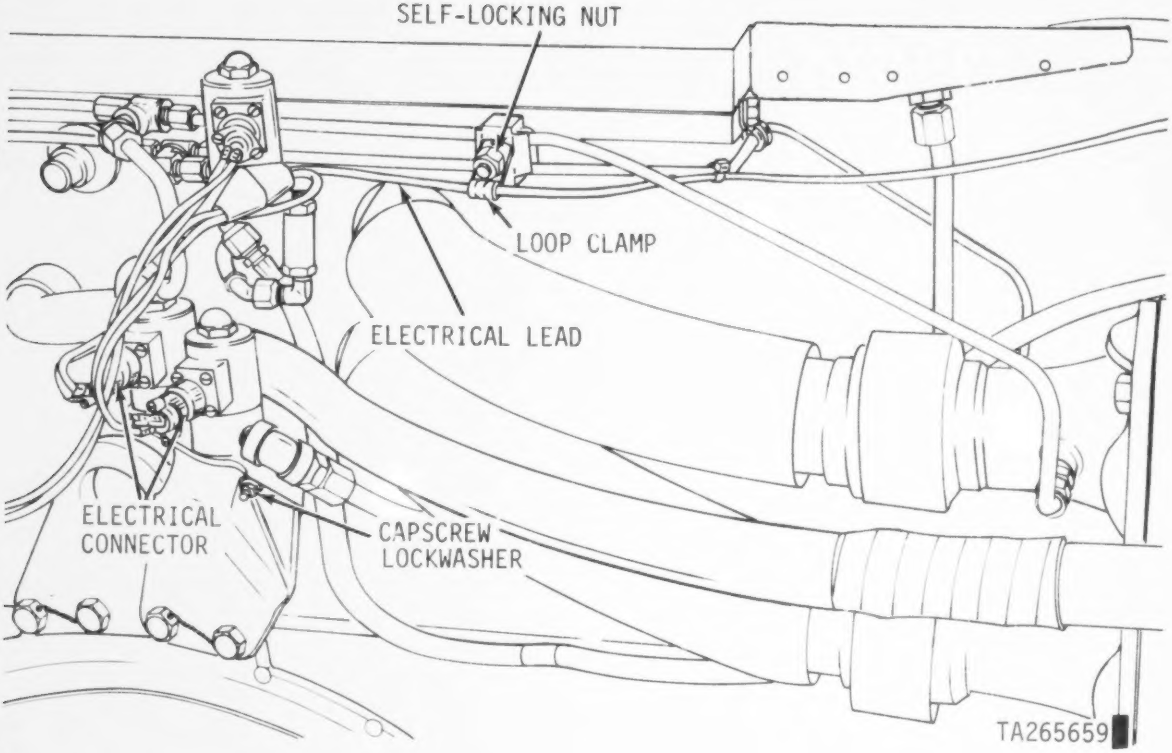

SELF-LOCKING NUT
LOOP CLAMP
ELECTRICAL LEAD
ELECTRICAL CONNECTOR
CAPSCREW LOCKWASHER
TA265659

Figure 2-136.2. Removing or installing smoke generating system electrical lead.

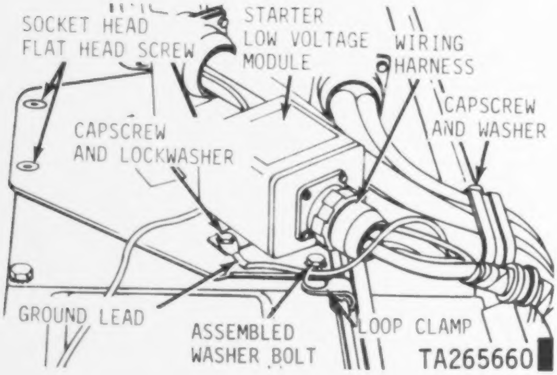

SOCKET HEAD FLAT HEAD SCREW
STARTER LOW VOLTAGE MODULE
WIRING HARNESS
CAPSCREW AND WASHER
CAPSCREW AND LOCKWASHER
GROUND LEAD
ASSEMBLED WASHER BOLT
LOOP CLAMP
TA265660

Figure 2-136.3 Removing or installing wiring harness mounting bracket, late engines.

(*f.2*) Disconnect wiring harness from starter low voltage protective module (fig. 2-136.3). Remove two capscrews and lockwashers securing ground lead and module to bracket. Remove and retain module. Remove two socket head capscrews, and three machine bolts and lockwashers and disconnect mounting bracket and loop clamp. Remove two capscrews and lockwashers and remove remaining strap and loop clamp.

(g) Remove machine screw and lockwasher (fig. 2-138) and remove loop clamp. Remove fuel solenoid cable connector and fuel shut-off cable connector.

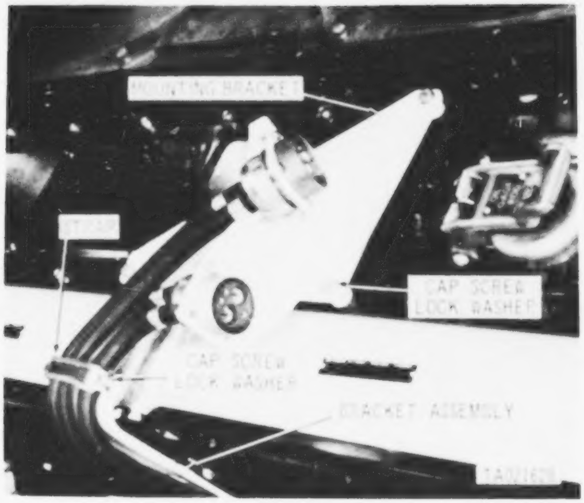

MOUNTING BRACKET
STRAP
CAP SCREW
LOCK WASHER
CAP SCREW
LOCK WASHER
BRACKET ASSEMBLY

Figure 2-137. Removing or installing starter cable mounting bracket, early engines.

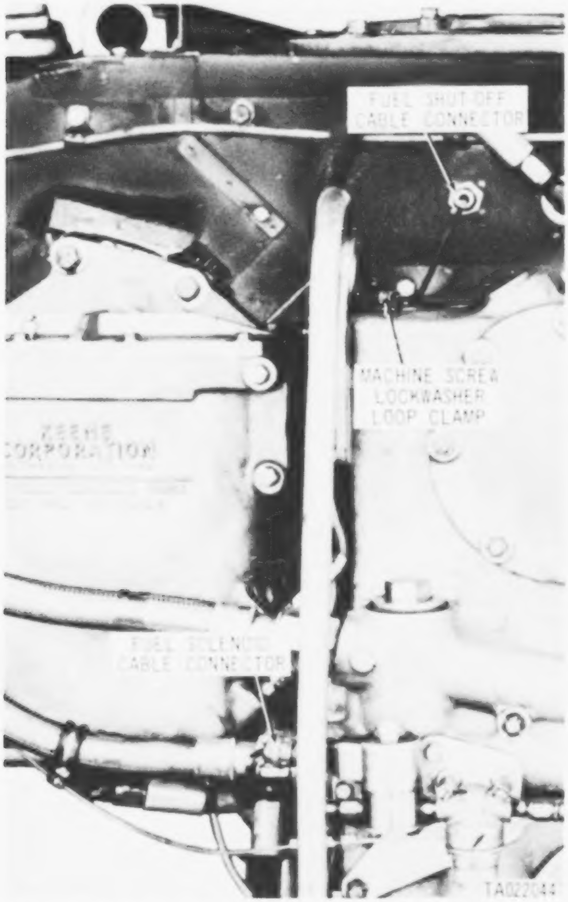

FUEL SHUT-OFF
CABLE CONNECTOR
MACHINE SCREW
LOCKWASHER
LOOP CLAMP
FUEL SOLENOID
CABLE CONNECTOR
TA022044

Figure 2-138. Removing or installing fuel solenoid and fuel shut-off connector.

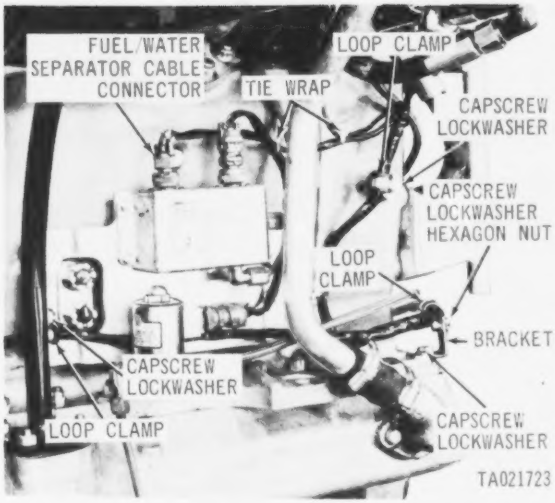
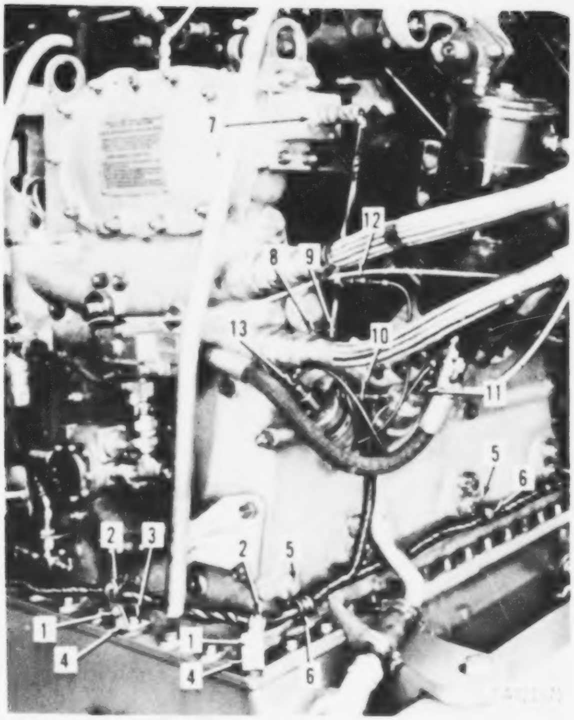

FUEL/WATER
SEPARATOR CABLE
CONNECTOR
TIE WRAP
LOOP CLAMP
CAPSCREW
LOCKWASHER
CAPSCREW
LOCKWASHER
HEXAGON NUT
LOOP
CLAMP
BRACKET
CAPSCREW
LOCKWASHER
LOOP CLAMP
CAPSCREW
LOCKWASHER
TA021723

Figure 2-139. Removing or installing fuel/water separator cable connector.

(*h*) Remove two capscrews and lockwashers (fig. 2-139) and remove two loop clamps. Cut tie-wrap and remove fuel/water separator cable connector. Remove capscrew and lockwasher and remove loop clamp. Remove capscrew and lockwasher and remove bracket.

(*i*) Remove two capscrews, lockwashers and hexagon nuts (1, fig. 2-140) and remove two loop clamps (2). Remove two capscrews and lockwashers (3) and remove two brackets (4). Remove two capscrews and lockwashers (5) and remove two loop clamps (6). Remove hour meter cable connector (7) and self-locking nut (8) and remove loop clamp (9). Remove high oil temperature switch cable electrical connector shell (10), oil pressure transmitter cable electrical connector shell (11), oil temperature transmitter cable electrical connector shell (12), and low oil pressure cable electrical connector shell (13).

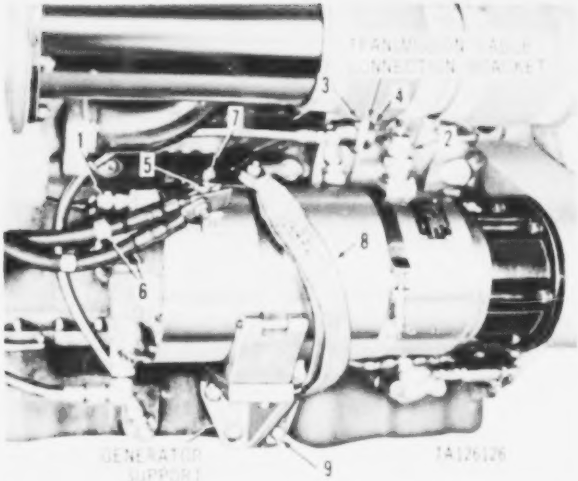
(*j*) Remove two generator wiring harness cable connectors (1 and 2, fig. 2-141). Remove four machine screws, lockwashers and hexagon nuts (3) and remove transmission disconnect cable connector (4). Remove self-locking nut and flat washer (5) and remove assembled buss bar and generator cable (6). Install flat washer and self-locking nut. Remove self-locking nut and flat washer (7) and disconnect assembled buss bar and ground strap (8). Install self-locking nut and flat washer. Remove capscrew and flat washer (9) and remove assembled buss bar and ground strap (8).


7
12
8
9
13
10
11
5
6
2
3
2
5
1
1
4
4
6

1 Capscrew and lockwasher
2 Loop clamp
3 Capscrew and lockwasher
4 Bracket
5 Capscrew and lockwasher
6 Loop clamp
7 Hour meter cable connector
8 Self-locking nut
9 Loop clamp
10 High oil temperature cable connector shell
11 Oil pressure transmitter cable connector shell
12 Oil temperature transmitter cable connector shell
13 Oil pressure cable connector shell

Figure 2-140. Removing or installing oil temperature and oil pressure electrical connectors.

(*k*) Remove two capscrews and lockwashers (fig. 2-142) and remove two loop clamps. Remove capscrew and lockwasher and remove terminal lug.


TRANSMISSION CABLE CONNECTION BRACKET
3
4
7
1
2
5
8
6
GENERATOR SUPPORT
9
TA126126

1 Cable connector
2 Cable connector
3 Machine screw, lock washer and nut
4 Cable connector
5 Self-locking nut and flat washer
6 Generator cable
7 Self-locking nut and flat washer
8 Ground strap
9 Capscrew and flat washer

Figure 2-141. Removing or installing generator and transmission electrical connectors.

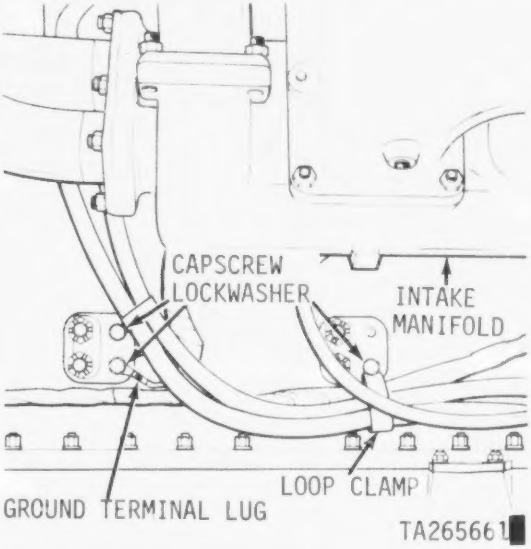

CAPSCREW
LOCKWASHER
INTAKE
MANIFOLD
LOOP CLAMP
GROUND TERMINAL LUG
TA265661

Figure 2-142. Removing or installing wiring harness and generator cable clamp.

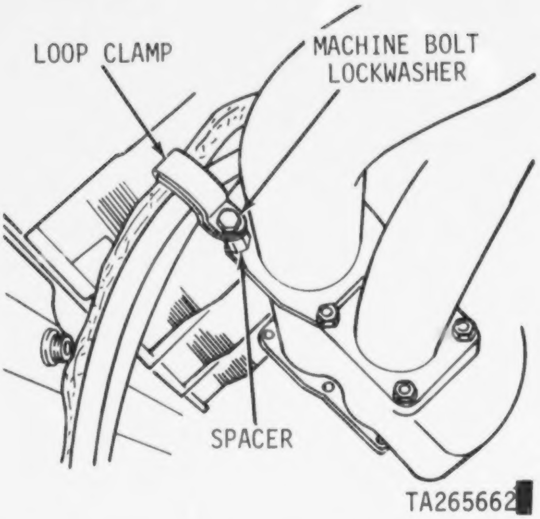

LOOP CLAMP
MACHINE BOLT
LOCKWASHER
SPACER
TA265662

Figure 2-142.1 Removing or installing wiring harness loop clamp.

(*k.1*) Remove one machine bolt and lockwasher (fig. 2-142.1). Remove loop clamp.

(*l*) Remove two capscrews and lockwashers (fig. 2-143) and remove two retaining straps. Remove two capscrews and lock nuts and remove bracket assembly. Remove manifold preheat cable connector.

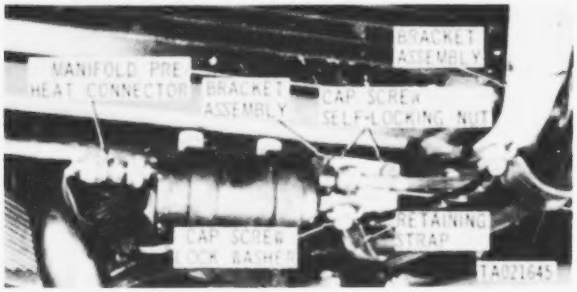

BRACKET ASSEMBLY
MANIFOLD PRE HEAT CONNECTOR
BRACKET ASSEMBLY
CAP SCREW SELF-LOCKING NUT
RETAINING STRAP
CAP SCREW LOCK WASHER
TA021645

Figure 2-143. Removing or installing wiring harness and generator cable bracket assembly.

(*m*) Remove two capscrews and lockwashers (fig. 2-144) and remove two retaining straps. Remove four capscrews and lockwashers and remove wiring harness, generator cables and mounting bracket.

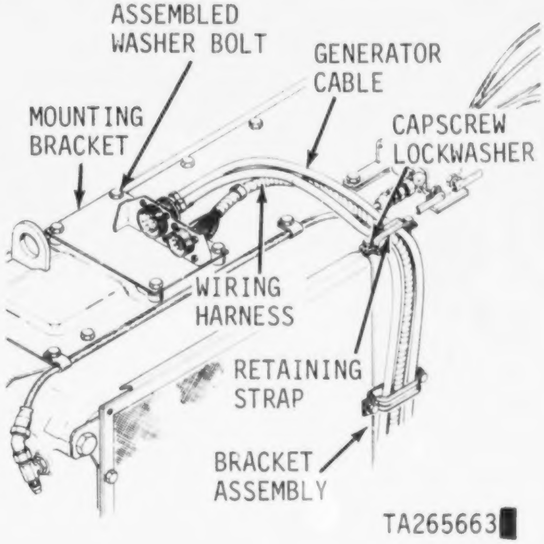

ASSEMBLED WASHER BOLT
GENERATOR CABLE
MOUNTING BRACKET
CAPSCREW
LOCKWASHER
WIRING HARNESS
RETAINING STRAP
BRACKET ASSEMBLY
TA265663

Figure 2-144. Removing or installing wiring harness and generator cable.

(*n*) Remove two assembled washer bolts (fig. 2-145) and remove wiring harness and generator cable bracket assembly. Remove starter cable bracket assembly in the same manner.

(2) *Installation*

(*a*) Install generator cable and wiring harness bracket assembly (fig. 2-145) and secure to center oil cooler mounting bracket with two assembled washer bolts. Install the starter cable bracket in the same manner.

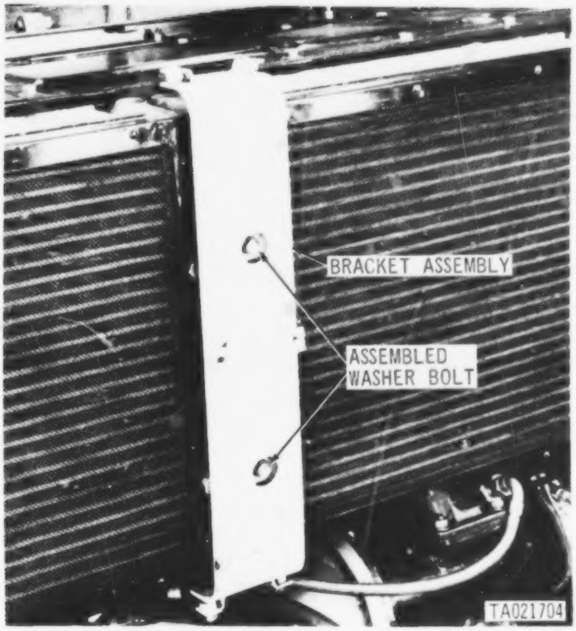


Figure 2-145. Removing or installing generator cable and wiring harness bracket.

(b) Position assembled mounting bracket (fig. 2-144) over the first four mounting holes immediately to the rear of the lifting eye which extends through the right front upper cover. Secure the bracket to the cover with four capscrews and lockwashers. Install two retaining straps on generator cable and wiring harness and secure to bracket assembly with four capscrews and lockwashers.

(*c*) Install bracket assembly (fig. 2-143) and secure to oil cooler frame with two capscrews and self-locking nuts. Install two retaining straps and secure one to each bracket assembly with two capscrews and lockwashers. Install manifold preheat cable connector.

(*c.1*) Position loop clamp (fig. 2-142.1) on spacer and secure with lockwasher and machine bolt.

(d) Install loop clamp (fig. 2-142) on generator cable and secure to crankcase with capscrew and lockwasher. Install loop clamp on generator cable and wiring harness and secure to crankcase with capscrew and self-locking nut. Secure wiring harness ground terminal lug to crankcase with capscrew and lockwasher.

(e) Clean electrical lead (ground) terminals. Install one flat washer in the generator support upper counterbore (fig. 2-17.1). Secure the inner lead with one flat washer and capscrew. Remove lower right generator support capscrew and flat washer. Discard capscrew. Install existing flat washer in the generator support counterbore. Secure outer lead with one flat washer and new capscrew (3/8-24 x 1-3/4 long). Torque tighten capscrews to 275 pound inches. Install assembled ground strap and buss bar on generator terminal and secure with self-locking nut and flat washer (7, fig. 2-141). Install assembled generator cable (6) on generator terminal and secure with self-locking nut and flat washer (5). Install transmission cable connector (4) in bracket and secure with four machine screws, lockwashers and hexagon nuts (3). Install generator cable connector (2) and (1).

(*f*) Install two loop clamps (6, fig. 2-140) and secure to crankcase and damper housing with two capscrews and lockwashers (5). Install two brackets (4) and secure to oil pan with two capscrews and lockwashers (3). Install two loop clamps (2) on wiring harness and secure to brackets with two capscrews, lockwashers and hexagon nuts (1). Install loop clamp (9) on wiring harness and secure to oil pressure regulator valve stud with self-locking nut (8). Install hour meter cable connector (7). Install low oil pressure (13) oil temperature (12) oil pressure (11) and high oil temperature (10) cable electrical connector shells.

(*g*) Install bracket (fig. 2-139) and secure to oil pan with capscrew and lockwasher. Install loop clamp on wiring harness and secure to bracket with capscrew, lockwasher and hexagon nut. Install two loop clamps and secure to crankcase with two capscrews and lockwashers. Install fuel/water separator cable connector.

(*h*) Install fuel shut-off cable connector (fig. 2-138) and fuel solenoid cable connector. Install loop clamp on fuel shut-off cable and secure to damper housing with machine screw and lockwasher.

(*i*) Install the assembled starter cable mounting bracket (fig. 2-137) and secure to left front upper cover with four capscrews and lockwashers. Install retaining strap on starter cables and secure to bracket assembly with two capscrews and lockwashers.

(i.1) On late engines install the assembled starter cable mounting bracket and loop clamp (fig. 2-136.3) and secure with two capscrews and three assembled washer bolts. Secure starter low voltage protective module and ground lead to bracket with two capscrews and lockwashers. Connect wiring harness to module.

(i.2) Secure ground lead to bracket with capscrew and lockwasher (fig. 2-136.2). Connect two electrical connectors to solenoid valves. Secure loop clamp (fig. 2-136.2) with self-locking nut. Secure two electrical lead loop clamps (fig. 2-136.1) to upper cover with two assembled washer bolts. Install loop clamp to the side of oil cooler support frame with assembled washer bolt.

(*j*) Install bracket assembly (fig. 2-136) and secure to oil cooler frame with two capscrews and self-locking nuts. Install three retaining straps and secure to the two bracket assemblies with six capscrews and self-locking nuts. Install manifold preheat cable connector.

(*k*) Install loop clamp (fig. 2-135) on starter cable and secure to intake manifold with self-locking nut. Install loop clamp on starter cable and secure to crankcase with capscrew and self-locking nut. Install loop clamp on wiring harness and secure to crankcase with capscrew and self-locking nut.

(*l*) Install starter low voltage protective module cable terminal lug (10, fig. 2-134), and two starter electrical cables (9) (circuit No. 81) on battery terminal and secure with hexagon nut and lockwasher (8).

(*m*) Install capscrew and flat washer (7) on ground strap (6) and secure to starter support.

(*n*) Install starter ground strap (6) and two starter ground cables (5) and secure with hexagon nut and lockwasher (4). Install starter low voltage protective module cable connector (3). Install loop clamp (2) on starter cables and wiring harness and secure to crankcase with capscrew and lockwasher (1).

b. Model AVDS-1790-2D.

(1) *Removal*

(*a*) Remove starter cables and wiring harness as outlined in paragraph 2-49a1(*a*) through (*h*).

(*b*) Remove two capscrews, lockwasher and flat washers (fig. 2-146) and remove generator air intake tube from generator blower motor housing.

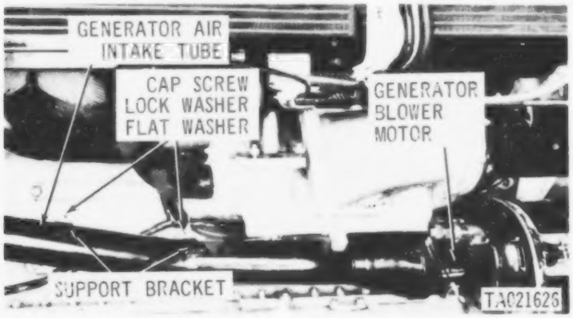
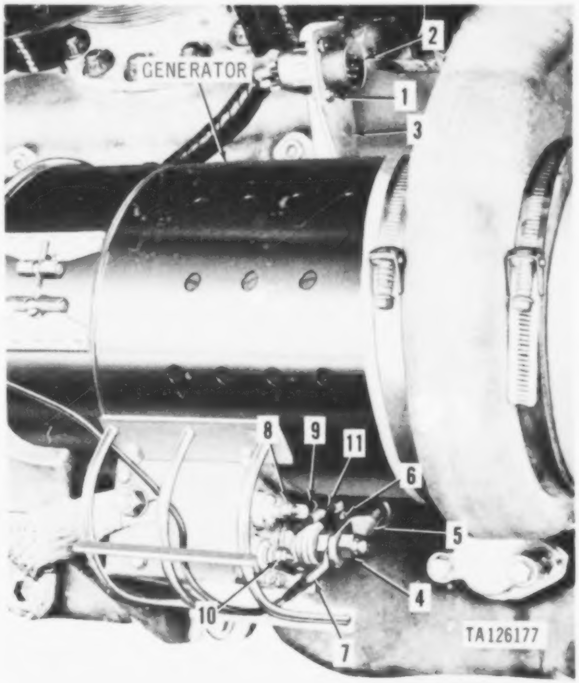


Figure 2-146. Removing or installing generator air intake tube, AVDS-1790-2D.

(*c*) Remove oil temperature and oil pressure cable connectors and wiring harness as outlined in par. 2-49a, (i).

(*d*) Remove four machine screws, lockwashers and hexagon nuts (1, fig. 2-147) and remove transmission disconnect cable connector (2) from bracket (3). Remove self-locking nut and flat washer (4) and remove generator cable (5) and electrical cable (6) and (7). Install self-locking nut and flat washer. Remove self-locking nut and flat washer. Remove self-locking nut and flat washer (8) and remove electrical cable (9). Install self-locking nut and flat washer. Remove self-locking nut and flat washer (10) and remove electrical cable (11). Install self-locking nut and flat washer.



1 Machine screw, lockwasher and hexagon nut
2 Cable connector
3 Bracket
4 Self-locking nut and flat washer
5 Generator cable
6 Electrical cable
7 Electrical cable
8 Self-locking nut and flat washer
9 Electrical cable
10 Self-locking nut and flat washer
11 Electrical cable

Figure 2-147. Removing or installing generator electrical cable and wiring harness, AVDS-1790-2D.

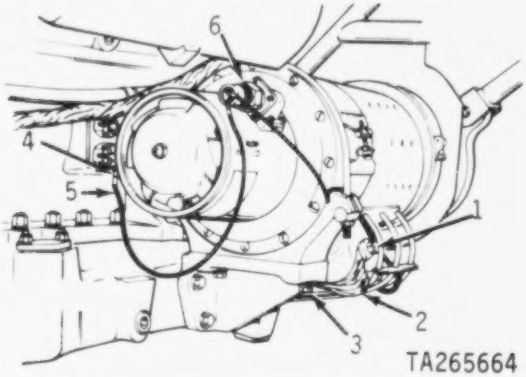
(e) Remove self-locking nut and flat washer (1, fig. 2-147.1) and disconnect ground strap (2). Install self-locking nut and flat washer. Remove screw and two flat washers (3) and remove ground strap. Remove capscrew and lockwasher (4) and remove cable terminal (5). Remove cable connector (6).

(f) Remove wiring harness, generator cable, clamp and brackets as outlined in paragraph 2-49a1(k) through (n).

(2) *Installation*

(a) Install generator cable, wiring harness, clamps and brackets as outlined in paragraph 2-49a2(a) through (d).

(b) Install cable connector (6, fig. 2-147.1) on generator blower motor. Install capscrew and lockwasher (4) on cable terminal (5) and secure to crankcase. Install ground strap (2) on generator terminal and secure with self-locking nut and flat washer (1). Install ground strap on generator cradle and secure with screw and two flat washers (3).



1 Self-locking nut and flat washer
2 Ground strap
3 Screw and flat washer
4 Capscrew and lockwasher
5 Cable terminal
6 Cable connector

Figure 2-147.1 Removing or installing generator cable connector and ground strap.

(c) Install cable terminal (11, fig. 2-147) circuit No. 478 on generator terminal "D" and secure with self-locking nut and flat washer (10). Install cable terminal (9) circuit No. 1, on generator terminal "A" and secure with self-locking nut and flat washer (8). Install electrical cable from blower motor (7), electrical cable (6) circuit No. 530, and generator cable (5) on generator terminal "B". Secure with self-locking nut and flat washer (4). Install transmission disconnect cable connector (2) in mounting bracket (3) and secure with four machine screws, lockwashers and hexagon nuts (1).

(d) Install loop clamp, bracket, oil temperature and oil pressure cable connectors and wiring harness as outlined in paragraph 2-49a2(f).

(e) Install generator air intake tube (fig. 2-146) on generator blower motor housing and secure to support bracket with two capscrews, lockwashers and flat washers.

(f) Install brackets, wiring harness, clamps and starter electrical cable as outlined in paragraph 2-49a2(h) through (n).

c. Model AVDS-1790-2DR

(1) Removal

(a) Cut and remove seven tie down straps (1, fig. 2-147.2). Remove capscrew and hexagon nut (2) and remove ground lead terminal from solenoid valve bracket. Disconnect two cable connectors (3) from smoke solenoid valves. Disconnect plug connector circuit No. T from starter ground harness. Remove cable assembly.

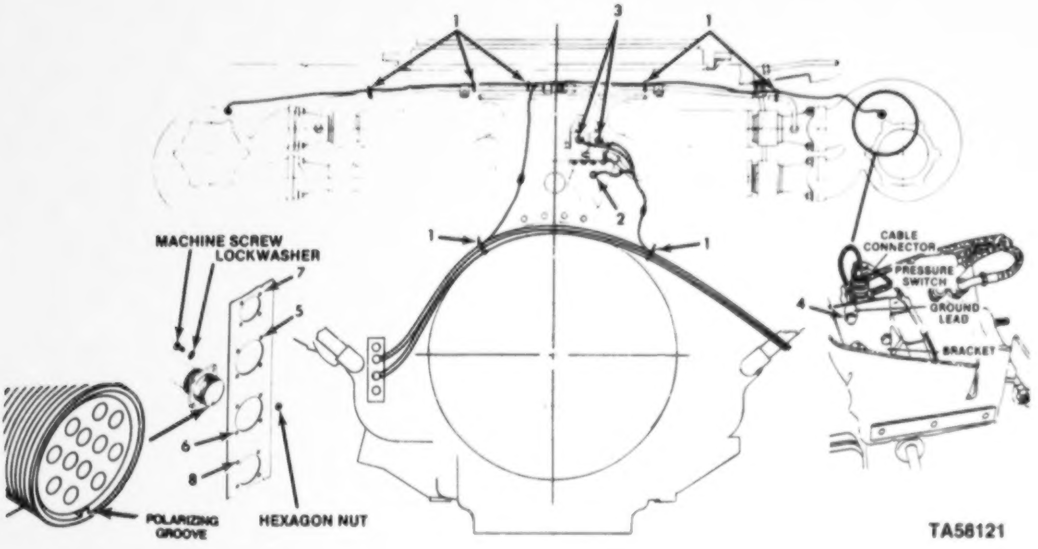
(b) Remove capscrew (4) and remove ground lead terminal from air pressure switch bracket. Disconnect cable connector from pressure switch. Disconnect plug connector circuit No. 510 from starter ground harness. Remove wiring harness.

NOTE

The opposite side harness connector and ground lead terminal removed in similar manner.

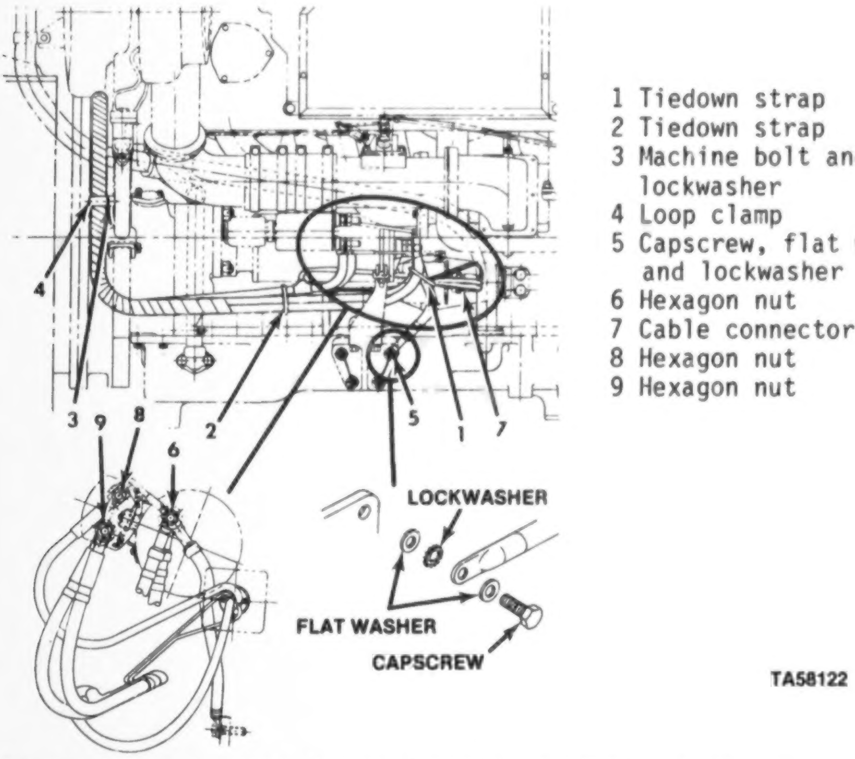
(c) Cut and remove tie down strap (1, fig. 2-147.3). Cut and remove tie down strap (2). Remove machine bolt and lockwasher (3) and remove loop clamp (4). Remove one capscrew, two flat washers and one lockwasher (5) and remove ground lead terminal lug from support bracket. Remove hexagon nut (6) and remove ground lead terminal lug from starter terminal stud. Remove lead.

(d) Remove two harness terminal lugs from starter terminal stud. Remove four machine screws, lockwashers and hexagon nuts (5, fig. 2-147.2) and remove connector from mounting bracket. Remove harness.


1
3
1
2
1
1
MACHINE SCREW
LOCKWASHER
7
5
6
8
POLARIZING GROOVE
HEXAGON NUT
CABLE CONNECTOR
PRESSURE SWITCH
GROUND LEAD
BRACKET
4
TA58121

1 Tiedown strap
2 Capscrew and hexagon nut
3 Cable connector
4 Capscrew
5 Machine screw, lockwasher and hexagon nut
6 Machine screw, lockwasher and hexagon nut
7 Machine screw, lockwasher and hexagon nut
8 Machine screw, lockwasher and hexagon nut

Figure 2-147.2 Removing or installing smoke generating cable, dust detector harness and wiring harness connectors, Model AVDS-1790-2DR


4
3
9
8
2
5
1
7
6
LOCKWASHER
FLAT WASHER
CAPSCREW
TA58122

1 Tiedown strap
2 Tiedown strap
3 Machine bolt and lockwasher
4 Loop clamp
5 Capscrew, flat washers and lockwasher
6 Hexagon nut
7 Cable connector
8 Hexagon nut
9 Hexagon nut

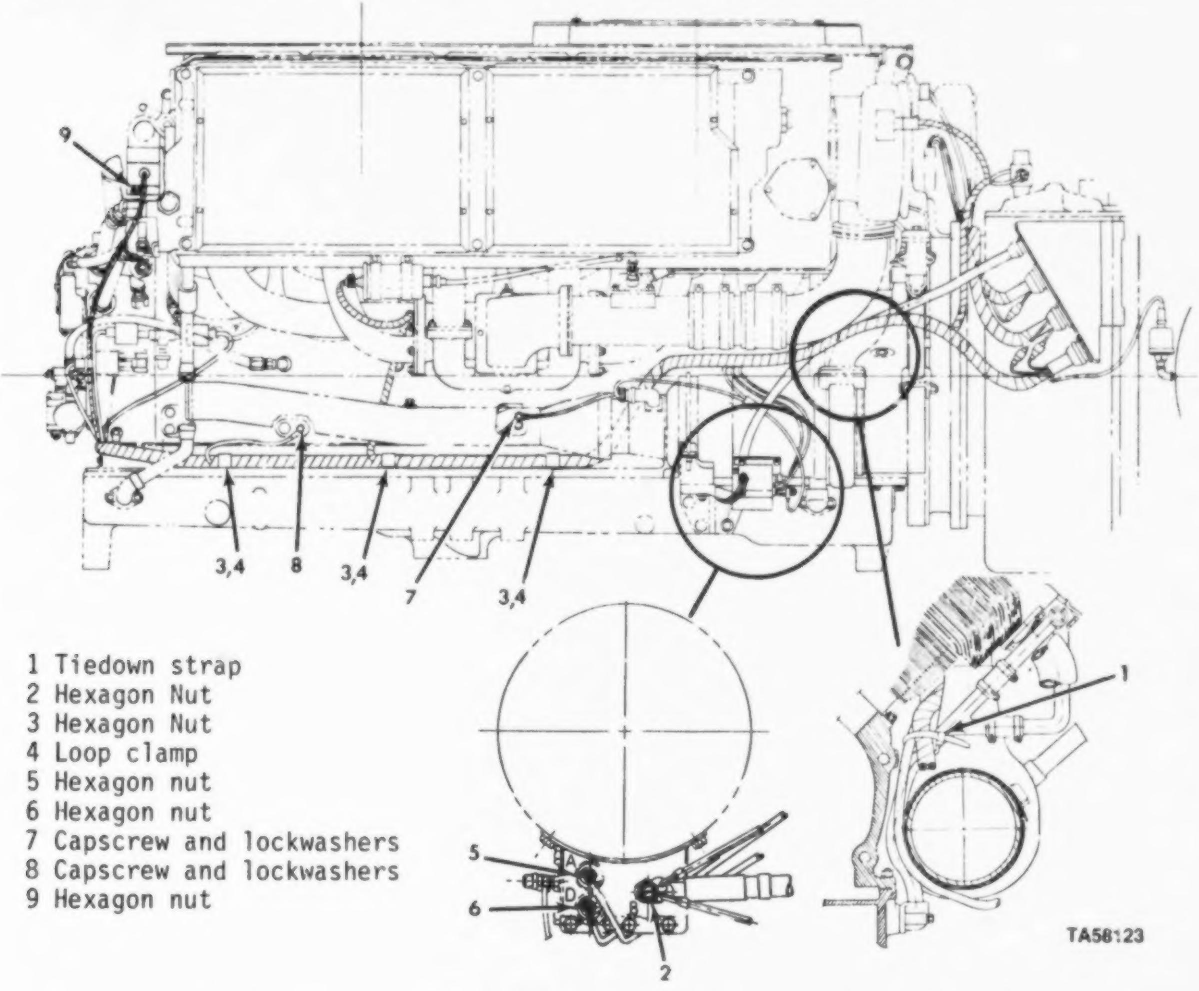
Figure 2-147.3 Removing or installing starter lead and wiring harnesses, Model AVDS-1790-2DR

(e) Disconnect plug connectors circuits No. C, K and M from main harness. Disconnect cable connector (7, fig. 2-147.3) from low voltage protection module. Remove hexagon nut (8) and terminal lug from starter relay terminal stud (motor). Remove hexagon nut (9) and two terminal lugs from starter relay terminal stud (battery). Remove four machine screws, lockwashers and hexagon nuts (6, fig. 2-147.2) and remove connector from mounting bracket. Remove wiring harness.

(f) Cut and remove one tie down strap (1, fig. 2-147.4). Remove hexagon nut (2) from generator radio supression capacitor marked B and remove terminal lugs circuits No. L and 26 part of main harness and remove lead terminal lug circuit No. 2. Remove four machine screws, lockwashers and hexagon nuts (7, fig. 2-147.2) and remove connector from mounting bracket. Remove lead.

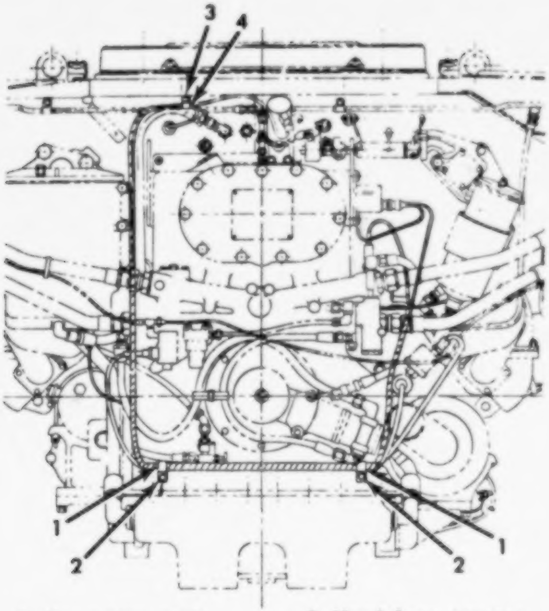
(g) Remove three hexagon nuts (3, fig. 2-147.4) from oil pan studs and remove three loop clamps (4). Remove two hexagon nuts (1, fig. 2-147.5) from damper housing studs and remove two loop clamps (2). Remove machine screw (3) and remove loop clamp (4).

(h) Disconnect plug connectors circuits No. 321, 324 and 509. Transmission oil pressure oil temperature and high oil temperature.



1 Tiedown strap
2 Hexagon Nut
3 Hexagon Nut
4 Loop clamp
5 Hexagon nut
6 Hexagon nut
7 Capscrew and lockwashers
8 Capscrew and lockwashers
9 Hexagon nut

Figure 2-147.4 Removing or installing generator lead and main wiring harness, Model AVDS-1790-2DR



1 Hexagon nut
2 Loop clamp
3 Machine screw
4 Loop clamp

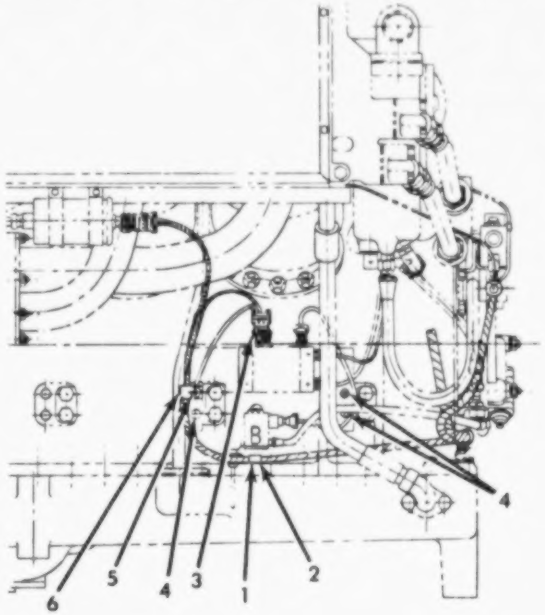
TA58124

Figure 2-147.5 Removing or installing main wiring harness, Model AVDS-1790-2DR.

(i) On engine assembly (right side), remove hexagon nut (5, fig. 2-147.4) and remove terminal lug from generator radio supression capacitor marked A. Remove hexagon nut (6) and remove terminal lug from capacitor marked D. Remove one capscrew and two lockwashers (7) and remove generator blower motor ground terminal lug. Disconnect cable connector from generator blower motor. Disconnect cable connector from manifold heater ignition unit (coil). Remove one capscrew and two lockwashers (8) and remove ground terminal lug. Disconnect two plug connectors circuit No. 509. High oil temperature and low oil pressure. Disconnect plug connectors circuits No. 33 and 36. Oil temperature and oil pressure. Disconnect plug connector circuit No. C, D and K to auxiliary generator oil pressure switch. Remove hexagon nut (9) and remove hour meter terminal lug ground. Disconnect cable connector circuit No. L to hour meter. Remove four machine screws, lockwashers and hexagon nuts (8, fig. 2-147.2) and remove connector from mounting bracket.

(j) On engine assembly (damper end), disconnect cable connector circuit No. 54 from fuel injection pump shut off lead assembly. Disconnect plug connector circuit No. 627 from throttle control solenoid. Disconnect cable connector circuit No. 486 from manifold heater solenoid valve.

(k) On engine assembly (left side), remove hexagon nut (1, fig. 2-148) and remove loop clamp (2). Disconnect cable connector (3) circuit No. N. Remove three machine bolts and lockwashers (4) from water separator control mounting plate. Remove one capscrew and two lockwashers (5). Remove loop clamp (6) and water drain module ground terminal lug. Disconnect cable connector circuit No. 486 from manifold heater ignition unit (coil).



1 Hexagon nut
2 Loop clamp
3 Cable connector
4 Machine bolts and lockwashers
5 Capscrew and lockwashers
6 Loop clamp

TA58125

Figure 2-148 Removing or installing fuel/water separator cable connector, Model AVDS-1790-2DR.

(1) On engine assembly (flywheel end), disconnect cable connector circuit No. 486 from manifold heater solenoid valve.

(2) Installation

(a) Positon wiring harness behind cylinder head oil drain tube (right rear), and connect cable connector circuit No. 415 to generator blower motor. Install terminal lug circuit No. 1 to generator supression capacitor marked A and secure with hexagon nut (5, fig. 2-147.4). Install terminal lug circuit No. 478 to capacitor marked D and secure with hexagon nut (6). Secure generator blower motor ground terminal lug to crankcase pad with one capscrew and two lockwashers (7). Connect cable connector circuit No. 486 to manifold heater ignition unit (coil). Secure ground terminal lug to crankcase pad with one capscrew and two lockwashers (8). Install three loop clamps (4) on harness and secure to oil pan studs with three hexagon nuts (3). Position harness behind intermediate oil pan drain tube (right front) and connect two plug connectors circuit No. 509 to switches high oil temperature and low oil pressure. Connect plug connectors circuits No. 33 and 36 to transmitters oil temperature and oil pressure. Connect plug connector circuit No. C, D and K to switch oil pressure auxiliary generator. Secure hour meter ground terminal lug to hour meter stud with hexagon nut (9). Connect cable connector circuit No. L to hour meter.

(b) On damper end, install two loop clamps (2, fig. 2-147.5) on harness and secure to damper housing studs with two hexagon nuts (1). Connect cable connector circuit No. 54 to injection pump shut off lead assembly. Connect plug connector circuit No. 627 to throttle control solenoid. Install loop clamp (4) to harness leads and secure to cooler vent hose loop clamp and shroud with machine screw (3). Connect cable connector circuit No. 486 to manifold heater solenoid valve.

(c) On left side, position harness behind intermediate oil pan drain tube (front) and install loop clamp (2, fig. 2-148) on harness and secure to oil pan stud with hexagon nut (1). Install loop clamp (6) to manifold heater ignition unit (coil) wire and with water drain module ground terminal lug secure to mounting plate and crankcase using one capscrew and two lockwashers (5). Reposition mounting plate and secure to crankcase with three machine bolts and lockwashers (4). Connect cable connector (3) circuit No. N to water drain control module. Connect cable connector circuit No. 486 to manifold heater ignition unit (coil).

(d) On flywheel end, connect cable connector circuit No. 486 to manifold heater solenoid valve. Connect plug connectors circuits No. 321, 324 and 509 to transmitters and switch transmission oil pressure, oil temperature and high oil temperature.

(e) On right side, install disconnect cable connector to mounting bracket and secure with four machine screws, lockwashers and hexagon nuts (8, fig. 2-147.2).

NOTE

Mount each disconnect cable connector with flange on cable side of mounting bracket and connector polarizing groove positioned at 6 o'clock.

(f) Install disconnect cable connector to mounting bracket and secure with four machine screws, lockwashers and hexagon nuts (7). Install terminal lugs (main harness) circuits No. L and 26 and terminal lug circuit No. 2 to generator radio suppression capacitor marked B and secure with hexagon nut (2, fig. 2-147.4). Install new tie down strap (1).

(g) Install disconnect cable connector to mounting bracket and secure with four machine screws, lockwashers and hexagon nuts (6, fig. 2-147.2). Position harness over transmission housing adapter and twist, as required, connecting cable connector (7, fig. 2-147.3) to low voltage protection module. Connect terminal lug circuit No. 74 to starter relay terminal stud (motor) and secure with hexagon nut (8). Connect two terminal lugs circuits No. 82 to starter relay terminal stud (battery) and secure with hexagon nut (9). Connect plug connectors circuits No. C, K and M to main harness mating plug connectors.

(h) Install disconnect cable connector to mounting bracket and secure with four machine screws, lockwashers and hexagon nuts (5, fig. 2-147.2). Position harness over transmission housing adapter and place two ground terminal lugs on starter terminal stud.

(i) Position ground terminal lug on starter support bracket and secure with one capscrew, two flat washers and one lockwasher (5, fig. 2-147.3). Install other ground terminal lug to starter terminal stud and secure with hexagon nut (6). Install loop clamp (4) on harnesses and secure to turbosupercharger support (left side) with machine bolt and lockwasher (3). Install new tie down strap (1) and (2).

(j) Connect cable connector circuit No. 510 to air pressure switch. Position ground terminal on switch bracket and secure with capscrew (4, fig. 2-147.2).

NOTE

The opposite side cable connector and ground terminal installed in similar manner.

Connect plug connector circuit No. 510 to starter ground harness mating plug connector.

(k) Connect two cable connectors (3) circuit No. T to smoke solenoid valves. Position ground terminal on solenoid valve bracket and secure with capscrew and hexagon nut (2). Connect plug connector circuit No. T to starter ground harness mating plug connector. Install seven new tie down straps (1).

2-49.1. Turbocharger Drive Housing (Power Take-off)

a. Removal.

(1) Disconnect fuel outlet hose (1, fig. 2-148.1) and fuel inlet hose (2) from respective elbows. Collect fuel in a suitable container and discard.

(2) Remove four self-locking nuts and flat washers (3) and remove fuel pump (4) from adapter. Remove and discard fuel pump mounting gasket (5). Disconnect oil inlet hose (6) at 45° elbow (7).

(3) Install holding bar and puller assembly (2, fig. 2-6) on power take-off drive coupling (1, fig. 2-148.2) and secure with two 7/16-20UNF x 1-1/2 inch capscrews (2). Hold holding bar and puller assembly to prevent crankshaft from turning, and remove self-locking nut (3) and flat washer (4). Remove holding bar and puller assembly.

(4) Install holding bar and puller assembly (2, fig. 2-6) on power take-off drive coupling (1, fig. 2-148.3), with boss against gearshaft, and secure with two 7/16-20UNFx1 1/2-inch capscrews (2). Alternately tighten the two capscrews and remove the power take-off drive coupling. Remove holding bar and puller assembly.

(5) Remove eight self-locking nuts and flat washers (3, fig. 2-148.3) and remove the power takeoff drive housing (5) and fuel hose clamps (4). Use two mechanical pullers (4, fig. 2-5) if necessary to assist in housing removal. Remove and discard mounting gasket (6).

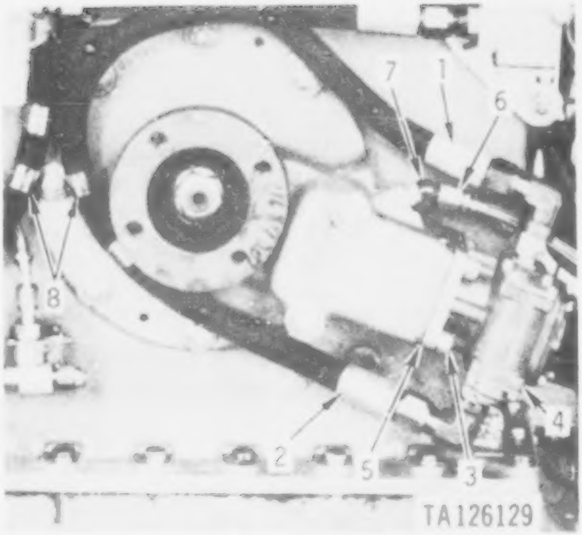
(6) Remove 45° elbow (7, fig. 2-148.3) from housing.

b. Installation.

(1) Install 45° elbow (removed above) in new power takeoff drive housing.

(2) Install power takeoff drive housing on studs using new mounting gasket (fig. 2-148.4).

(3) On engines using the late spur gearshaft (with 7/8-14 inch threads), use alinement tool, Part No. 12275768. On engines using the early spur gearshaft (with 3/4-16 inch threads), use alinement tool, Part No. 11684212. Remove puller screw from alinement tool. Insert alinement tool in power takeoff drive housing until firmly seated on the power takeoff spur gearshaft taper. With the alinement tool firmly seated on the spur gearshaft, install seven self-locking nuts and flat washers. Do not install self-locking nut and flat washer on stud located at the 9 o'clock position. Install puller screw and turn clockwise to remove alinement tool.



1 Fuel outlet hose
2 Fuel inlet hose
3 Self-locking nut and flat washer
4 Fuel pump
5 Gasket
6 Oil inlet hose
7 45° elbow
8 Hose clamp

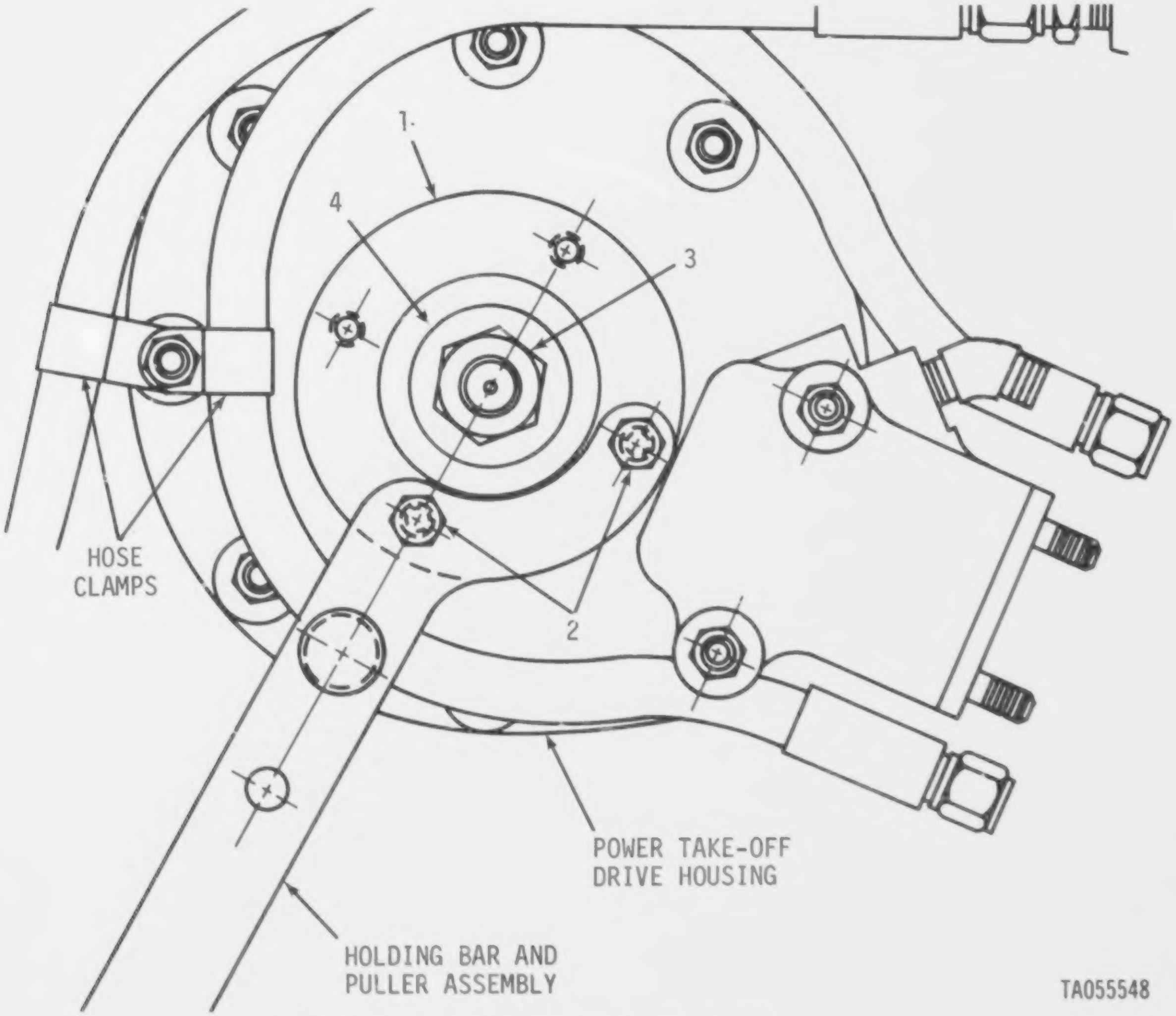
Figure 2-148.1. Removing or installing fuel pump, model AVDS-1790-2DR engine.

NOTE

Drive coupling taper and spur gearshaft taper areas must be wiped dry with dry-cleaning solvent (P-D-680) to assure maximum friction.

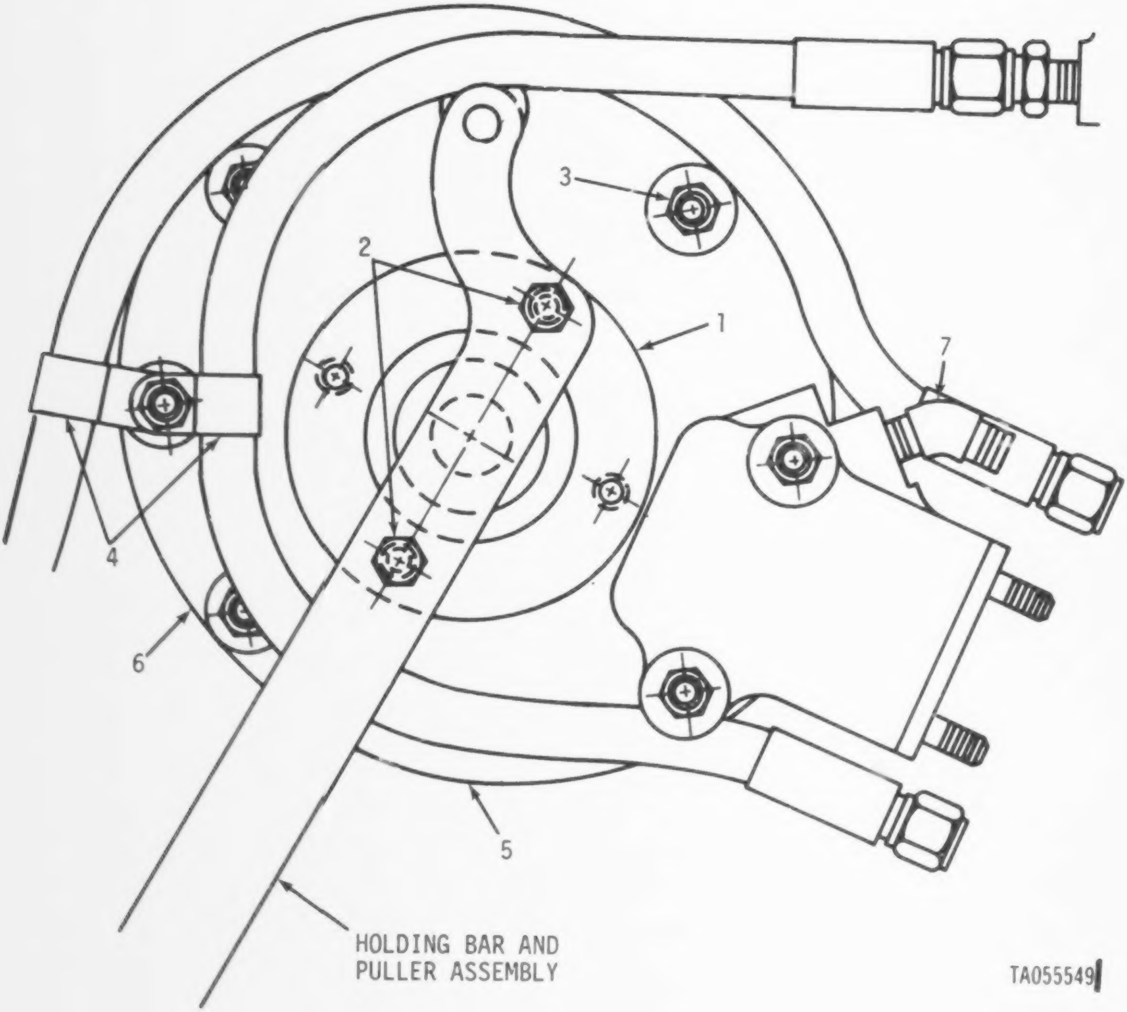
(4) On late engines (spur gearshaft with 7/8-14 threads) install power take-off drive coupling (1, fig. 2-148.2) and flat washer (4). Be certain power takeoff spur gearshaft and coupling taper surfaces are dry and free from oil and grease. Coat nut threads only with engine oil OE/HDO-30, or equivalent, and install self-locking nut (3). Install holding bar and puller assembly, Part No. 12254282, on power take-off drive coupling and secure with two 7/16-20 UNF x 1-1/2 inch capscrews (2). Hold holding bar and puller assembly to prevent crankshaft from turning, and torque tighten self-locking nut to 280 - 290 pounds feet. Remove puller assembly.

(4.1) On early engines (spur gearshaft with 3/4-16 threads) install power take-off drive coupling (1, fig. 2-148.2) and flat washer (4). Be certain spur gearshaft threads are dry and free from oil or grease. Coat nut threads with engine oil OE/HD0-30, or equivalent, and install nut (3). Install holding bar and puller assembly, Part No. 12254282, on power take-off drive coupling and secure with two 7/16-20UNF x 1-1/2 inch capscrews (2). Hold holding bar and puller assembly to prevent crankshaft from turning. Note the prevailing nut torque (before nut bottoms against the flat washer), and add 190 pound-feet torque to complete the torque tightening procedure. Remove puller assembly.



1 Power take-off drive coupling
2 Capscrew
3 Self-locking nut
4 Flat washer

Figure 2-148.2. Removing or installing power take-off drive coupling self-locking nut, model AVDS-1790-2DR engine.



1
2
3
4
5
6
7
HOLDING BAR AND PULLER ASSEMBLY
TA055549

1 Power takeoff drive coupling
2 Capscrew
3 Self-locking nut and flat washer
4 Hose clamp
5 Power takeoff drive housing
6 Gasket
7 45° elbow

Figure 2-148.3. Removing power takeoff drive coupling and housing, model AVDS-1790-2DR engine.

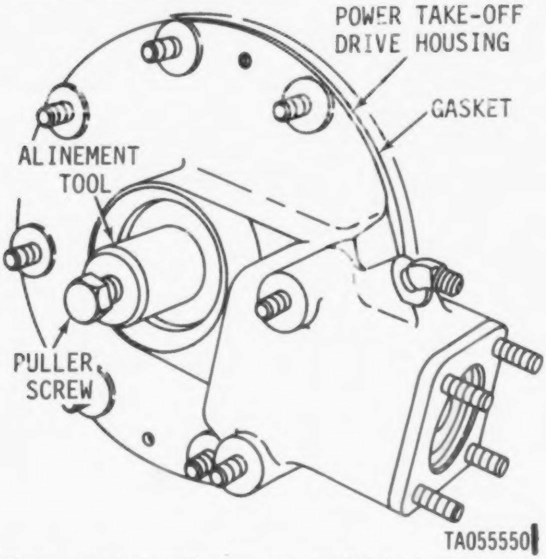


Figure 2-148.4. Installing power takeoff drive housing using alinement tool, model AVDS-1790-2DR engine.

(5) Connect oil inlet hose (6, fig. 2-148.1). Install fuel pump (4) using new gasket (5) and secure with four self-locking nuts and flat washers (3). Connect fuel inlet hose (2) and fuel outlet hose (1) to fuel pump elbows.

(6) Install fuel inlet and outlet hose clamps (8) on stud at 9 o'clock position and secure with self-locking nut and flat washer (3, fig. 2-148.3).

NOTE

> Open bleeder valve on fuel/water separator filter and purge fuel system (para 2-23). Close bleeder valve after purging system.

2-49.2. Throttle Control Solenoid Assembly

a. Removal.

(1) Remove capscrew and self-locking nut (1, fig. 2-148.5) and separate control rod from injection pump fuel lever (2). Remove cotter pin (3) and flat washer (4) and disconnect rod from manual fuel shut-off lever (5). Discard cotter pin. Remove two capscrews and lockwashers (6) securing fuel filter bracket (7) and camshaft end plate (10) to the cylinder.

(2) Remove two machine bolts and lockwashers (8) securing cross shaft support to damper and filter housing, and one capscrew and lockwasher (9) securing camshaft end plate (10) to cylinder and remove end plate and throttle linkage cross shaft (11) as an assembly. Remove and discard end plate mounting gasket (12).

(3) Remove right camshaft end plate (1, fig. 2-148.6). Remove retaining ring (2), ball bearing (3) and retaining ring (4) from shaft. Loosen capscrew (5) and remove lever (6) and Woodruff key (not shown). Remove retaining ring (7), lever (8) and retaining ring (9) from shaft. Loosen capscrew (10) and remove lever (11) and Woodruff key (not shown). Remove spacer (12), block (13) and spacer (14). Remove retaining ring (15), lever (16) and retaining ring (17) from throttle control solenoid assembly (18). Refer to figure 3-258, item 44 for removal of cover from camshaft end plate (1, fig. 2-148.6).

b. Installation.

(1) Install retaining ring (17, fig. 2-148.6), lever (16) and retaining ring (15) on new throttle control solenoid assembly (18). Install spacer (14), block (13) and spacer (12). Install Woodruff key, lever (11) and tighten capscrew (10). Install retaining ring (9), lever (8) and retaining ring (7). Install Woodruff key and lever (6) and tighten capscrew (5). Install retaining ring (4), ball bearing (3) and retaining ring (2). Install camshaft end plate (1).

(2) Install throttle control solenoid and throttle linkage cross shaft assembly (11, fig. 2-148.5) on engine using new end plate mounting gasket (12). Install two machine bolts and lockwashers (8) and one capscrew and lockwasher (9). Install fuel filter bracket (7) and secure with two capscrews and lockwashers (6). Connect rod to manual fuel shutoff lever (5) and secure with flat washer (4) and new cotter pin (3). Connect control rod to injection pump fuel lever (2) and secure with capscrew and self-locking nut (1).

c. Adjust Idle Speed Screw.

(1) Start and operate engine until normal operating speed is reached.

(2) With engine running, loosen locknut on idle speed adjusting screw (fig. 2-148.7).

(3) Turn idle speed adjusting screw until 700 rpm is obtained. Turn screw clockwise to increase speed, and counterclockwise to decrease speed. Tighten locknut.

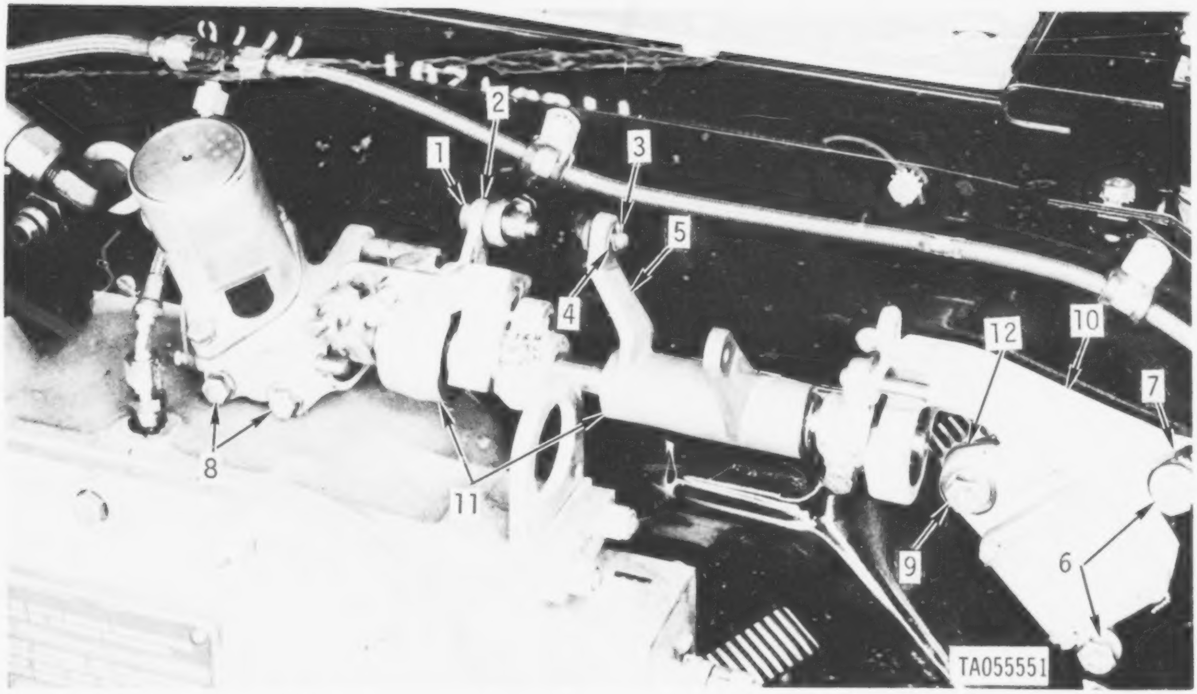
d. Adjust Solenoid Control Speed Screw.

(1) With engine running at normal operating temperature, loosen locknut on solenoid control speed screw (fig. 2-148.7). Activate power take-off and have an assistant increase engine speed to 1800 rpm.

(2) If 1800 rpm cannot be obtained when speed control screw engages stop, turn screw counterclockwise to increase engine rpm. If screw has not engaged stop when 1800 rpm are obtained, turn screw clockwise until screw engages stop.

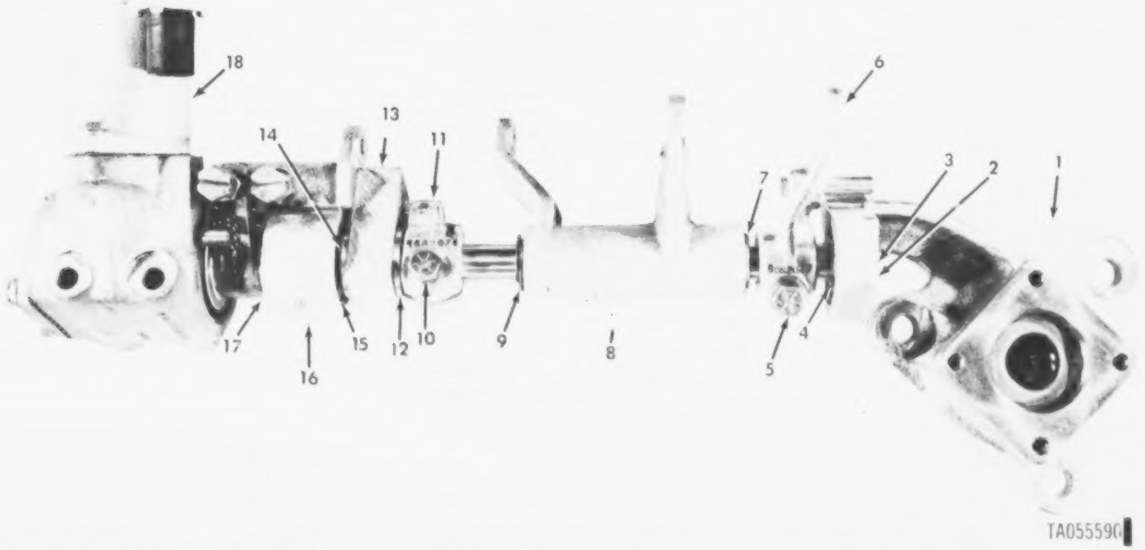
(3) Allow engine to return to idle speed. Increase engine speed to 1800 rpm and recheck adjustment. If adjustment is not correct, repeat step (2) above.

(4) Tighten locknut after correct rpm (1800 rpm no load) is obtained. Stop engine.



1 Capscrew and self-locking nut
2 Injection pump fuel lever
3 Cotter pin
4 Flat washer
5 Manual fuel shut-off lever
6 Capscrew and lockwasher
7 Fuel filter bracket
8 Machine bolt and lockwasher
9 Capscrew and lockwasher
10 Camshaft end plate
11 Throttle linkage cross shaft
12 Gasket

Figure 2-148.5. Removing or installing throttle control solenoid assembly and cross shaft assembly, model AVDS-1790-2DR engine.



1 Camshaft end plate
2 Retaining ring
3 Ball bearing
4 Retaining ring
5 Capscrew
6 Lever
7 Retaining ring
8 Lever
9 Retaining ring
10 Capscrew
11 Lever
12 Spacer
13 Block
14 Spacer
15 Retaining ring
16 Lever
17 Retaining ring
18 Throttle control solenoid assembly

Figure 2-148.6. Removing or installing throttle control levers and associated parts from throttle control solenoid assembly, model AVDS-1790-2DR engine – continued.

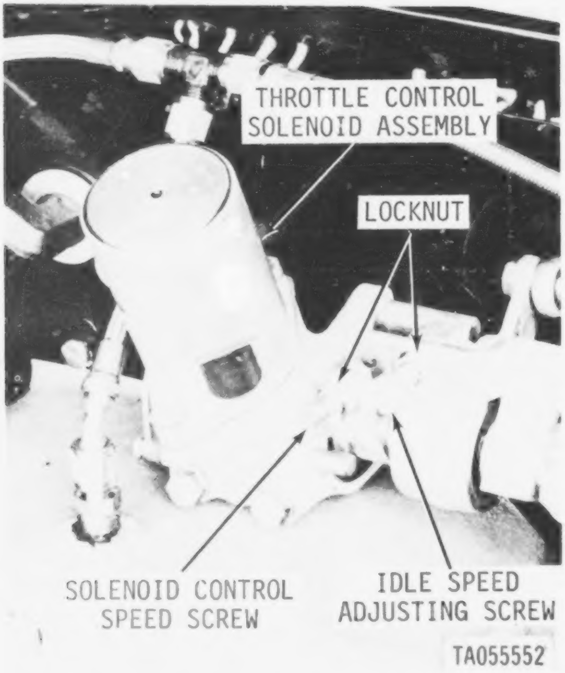

THROTTLE CONTROL SOLENOID ASSEMBLY
LOCKNUT
SOLENOID CONTROL SPEED SCREW
IDLE SPEED ADJUSTING SCREW
TA055552

Figure 2-148.7. Idle and solenoid control speed screws, model AVDS-1790-2DR.

2-49.3. Smoke Generating Solenoid Valves and Fuel Shut-Off Valve

NOTE

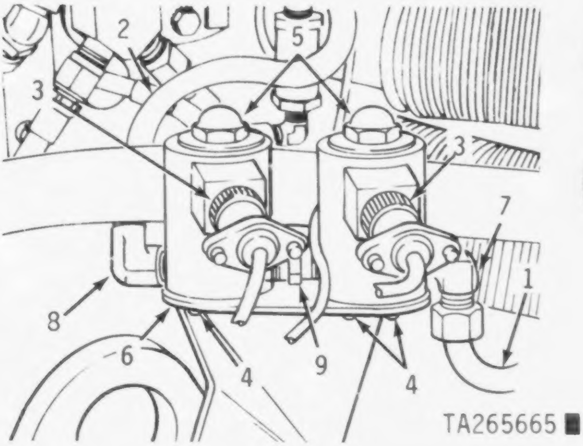
Model AVDS-1790-2DR is not equipped with a wiring harness.

a. Removal.

(1) Disconnect fuel inlet tube (1, fig. 2-148.8) and fuel outlet tube (2) from solenoid elbows. Disconnect two electrical connectors (3) from solenoid valves (5) Remove four assembled washer bolts and flat washers (4) securing solenoid valves (5) to mounting bracket (6). Remove solenoid valves. Remove capscrew and lockwasher securing ground wire to bracket. Remove ground wire. Cut lockwire and remove two capscrews securing mounting bracket (6) to lifting eye. Remove bracket. Place solenoid valves in a soft jawed vise and remove fuel inlet elbow (7), outlet elbow (8) and nipple (8).

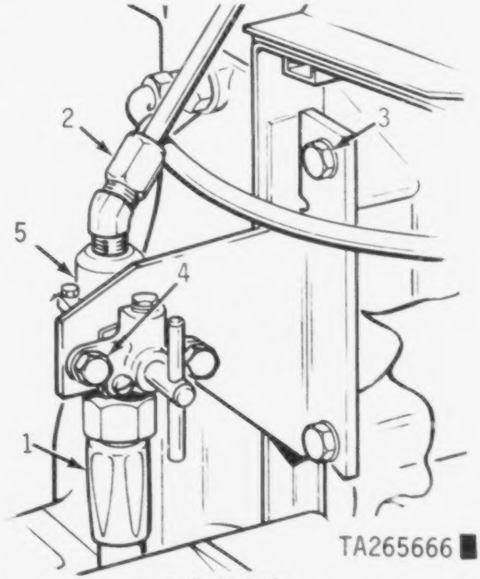
(2) Loosen tube nut and remove fuel outlet tube (2, fig. 2-148.9) from fuel shut-off valve (5). Loosen and remove fuel inlet hose (1) from valve. Remove two assembled washer bolts (3) attaching bracket to shroud plate and remove valve and bracket as an assembly. Separate fuel shut-off valve (5) from mounting bracket by removing two self-locking nuts and capscrews (4).

(3) Deleted.



1 Fuel inlet tube
2 Fuel outlet tube
3 Electrical connector
4 Assembled washer bolt and flat washer
5 Solenoid valve
6 Mounting bracket
7 Fuel inlet elbow
8 Outlet elbow
9 Nipple

Figure 2-148.8. Removing or installing smoke generating system fuel solenoid valves.



1 Fuel inlet hose
2 Fuel outlet hose
3 Self-locking nut
4 Capscrew
5 Fuel shut-off valve

Figure 2-148.9. Removing or installing fuel shut-off valve

b. Installation.

(1) Secure fuel shut-off valve (5, fig. 2-148.9) to mounting bracket with two capscrews and self-locking nuts (4). Attach mounting bracket to shroud plate with two assembled washer bolts (3). Connect fuel inlet hose (1) and fuel outlet tube (2) to shut-off valve.

NOTE

Check position of electrical connectors on new solenoid valves. Hold the valve with the inlet port marked "IN" to the right and the outlet port marked "OUT" to the left side. The electrical connectors must be approximately 45 degrees from the inlet ports, and pointing toward you. If the connectors must be repositioned, place the valves in a soft jawed vise. Loosen the acorn nut on top of the valves. Rotate the connectors and torque tighten acorn nuts to 50 pound inches. Remove and discard protective covers and felt filtering disks (if present) from inlet and outlet ports.

(2) Install nipple (9, fig. 2-148.8) in outlet port of one valve and inlet port of the other valve. The bottom surfaces of the two valves must be parallel.

(3) Place valves in a soft jawed vise. Install outlet elbow (8) in valve outlet port and tighten so outlet leg is at twelve o'clock position. Install fuel inlet elbow (7) in valve inlet port and tighten so inlet leg is at the five o'clock position.

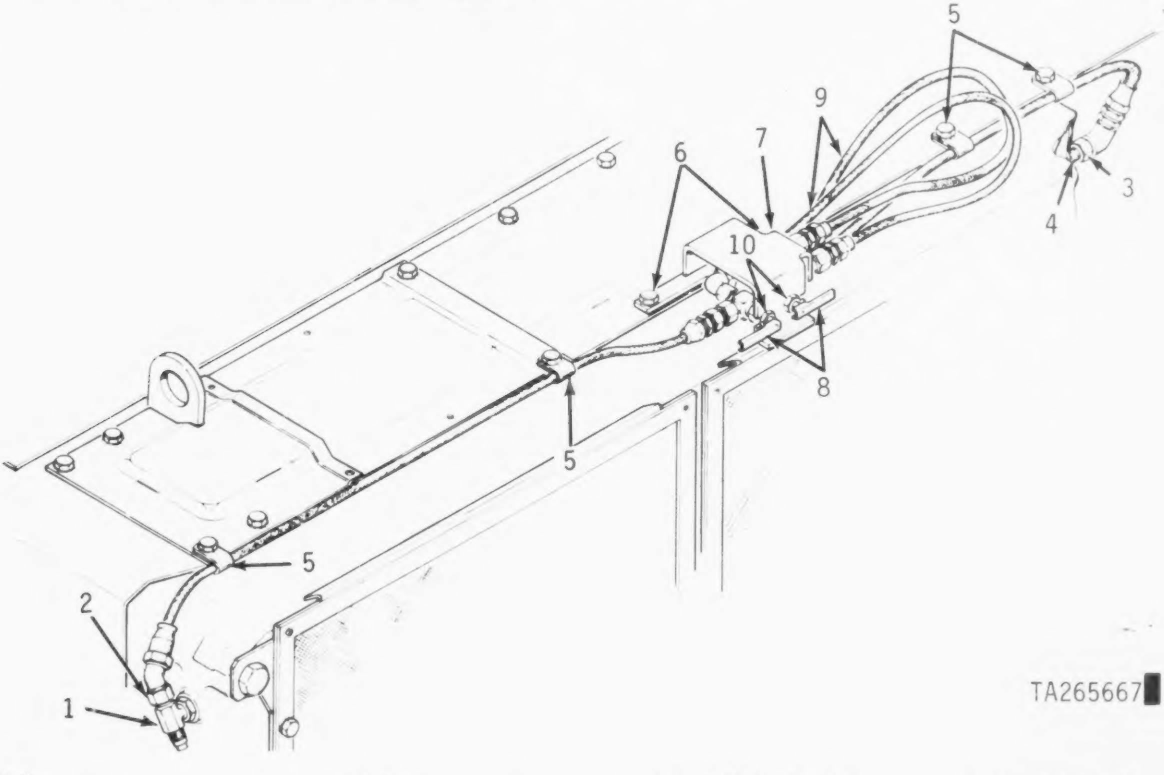
(4) Install mounting bracket (6) and secure with two capscrews and locking wire. Install the assembled valves on the mounting bracket (6) and secure with four assembled washer bolts and flat washers (4). Secure ground lead to bracket with capscrew and lockwasher. Connect fuel inlet tube (1) and fuel outlet tube (2) and attach electrical connectors (3) to solenoid valves (5).

2-49.4. Oil Sampling System

a. Removal

(1) Disconnect coupling nut of engine oil line (2, fig. 2-148.10) from tee (1), and coupling nut of transmission oil line (3) from adapter (4). Remove four assembled washer bolts and four loop clamps (5) from right front and rear upper covers. Remove two assembled washer bolts (6) and remove sampling valves mounting bracket (7). Remove oil sampling system as an assembly.

(2) Place mounting bracket (7) in a vise and remove inlet lines (2 and 3) from the side fitting



1 Tee
2 Engine oil inlet line
3 Transmission oil inlet line
4 Adapter
5 Assembled washer bolt and loop clamp
6 Assembled washer bolt
7 Oil sampling valve bracket
8 Toggle valve
9 Oil sampling line
10 Locking nut

Figure 2-148.10. Removing or installing oil sampling system.

of each valve (8). Disconnect two outlet hoses (9) from two fittings on side of mounting bracket (7). Disconnect two outlet hoses (9) from bottom fitting on each valve. Remove outlet hoses. Loosen locking nut (10) on each valve and slide valves out of mounting bracket.

(3) On AVDS-1790-2DR only, remove oil sampling valve from front of oil filter housing cover (fig. 1-7.3).

b. Installation.

(1) Install mounting bracket in a vise, and install the valves as shown in figure 2-148.11, with the handles and the inlet ports facing opposite each other and parallel to bottom flanges of mounting bracket. Secure both valves in mounting bracket by tightening jam nut while holding a wrench on nut directly behind bracket wall.

(2) Connect outlet hoses to valves (fig. 2-148.11). Connect opposite ends of two outlet hoses to fittings on mounting bracket side flange.

(3) Attach engine oil inlet line (fig. 2-148.11) to left valve. Attach transmission oil inlet line to right valve.

(4) Remove oil sampling valve assembly from vise and secure to right rear upper cover with two assembled washer bolts (6, fig. 2-148.10).

(5) Attach transmission oil inlet line (3) to adapter (4). Attach engine oil inlet line (2) to tee (1). Secure both inlet lines to right upper covers with four assembled washer bolts and loop clamps (5).

(6) On Model AVDS-1790-2DR only, install one oil sampling toggle valve to oil filter housing front cover (fig. 1-7.3).

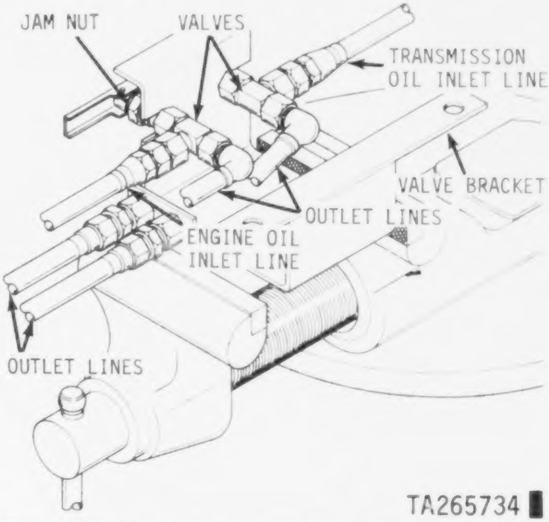


Figure 2-148.11. Removing or installing oil sampling valves in bracket

2-49.5. Clean Air System

Refer to Chapter 4 for removal and installation procedures for the clean air system on models AVDS-1790-2CA and AVDS-1790-2DA.

Section VI. SERVICE OPERATIONS

2-50. General

This section covers service operations allocated to the Direct Support and General Support Maintenance Organization. Procedures outlined in this section are for service operations requiring a minimum of engine disassembly to perform.

2-51. Checking Cylinder Compression

a. General. For instructional purposes in this section all fuel injector nozzle and holder assemblies will be removed and a compression test will be made on all cylinders.

WARNING

It is recommended that all nozzles be removed when performing a compression check. Nozzle removal will prevent the possibility of the engine firing on other cylinders when the engine is cranked, and will permit the engine to be cranked at the desired RPM to check compression.

b. Starting engine. Check the vehicle batteries to assure a full charge, and replace if necessary. Refer to the pertinent operator's manual for engine starting procedures. Start engine and allow engine to reach normal operating temperature and then stop engine. Cut off fuel supply so engine will not deliver fuel while performing compression test.

NOTE

Compression testing must be performed within an hour after stopping the engine.

c. Disassembly.

(1) Remove cooling fan vanes, cooling fans, engine upper covers, cooling fan shroud, and fuel injector tubes, refer to paragraph 2-21*a*.

(2) Remove fuel injector nozzle and holder assemblies, refer to paragraph 2-30*a*.

d. Compression Test.

(1) Position new injector nozzle gasket (fig. 2-149) on end of compression adapter, Part No. 8743025. Apply a light coating of grease on gasket so it adheres to adapter when installed in cylinder.

(2) Install adapter into fuel injector nozzle holder opening and tighten securely using crowfoot attachment, Part No. 12254244.

(3) Install gage assembly, Part No. 10899180 (fig. 2-150) on adapter, Part No. 8743025 and

tighten securely. Crank engine several seconds, or until the compression gage reaches maximum reading. Cylinder compression must be within 330 to 480 psi at engine cranking speed. Depress gage vent valve (fig. 2-150) to release pressure and reset gage to zero after compression reading is taken. Test compression on all cylinders in the same manner.

NOTE

High cylinder pressures are caused by combustion of lubricating oil in the engine combustion chamber. If this occurs, allow combustion gases to escape prior to taking compression readings by motoring the engine with the starter for 30 seconds with the fuel supply shut off.

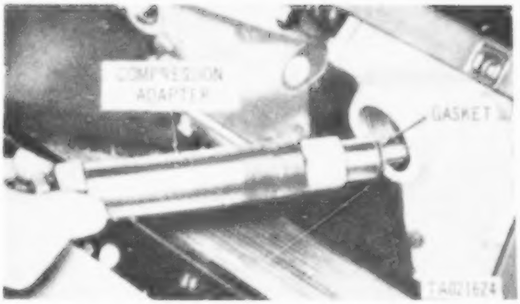


Figure 2-149. Installing or removing compression adapter.

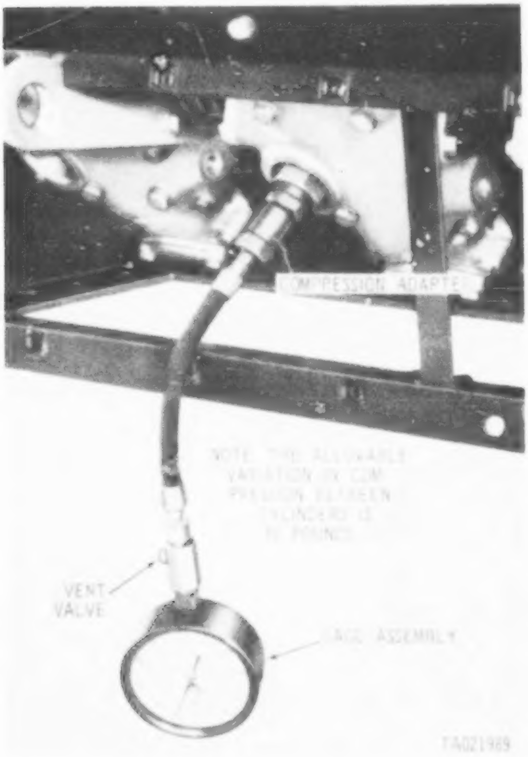

COMPRESSION ADAPTER
NOTE: THE ALLOWABLE VARIATION IN COMPRESSION BETWEEN CYLINDERS IS 70 POUNDS
VENT VALVE
GAGE ASSEMBLY
TA021989

Figure 2-150. Checking cylinder compression.

e. Compression Variation. After all 12 cylinders are checked, determine the pressure difference between high and low cylinder reading. This variation should not exceed 70 psi. If compression readings are below the low limit of 330 psi, the engine motoring RPM should be checked to be sure that it is 140 to 180 RPM. Compression should be checked again to confirm the previous readings before submitting an engine for overhaul. Remove compression gage from adapter. Remove adapter and gasket (fig. 2-149). Discard gasket.

f. Assembly. Install fuel injector nozzle and holder assemblies, paragraph 2-48*b*. Install fuel injector tubes, paragraph 2-21*b*. Install oil coolers, cooling fan shroud, engine upper covers, cooling fans and cooling fan vanes, refer to paragraph 2-27*b* and paragraph 2-21*b*.

2-52. Adjusting Intake and Exhaust Valve Clearance

a. Disassembly.

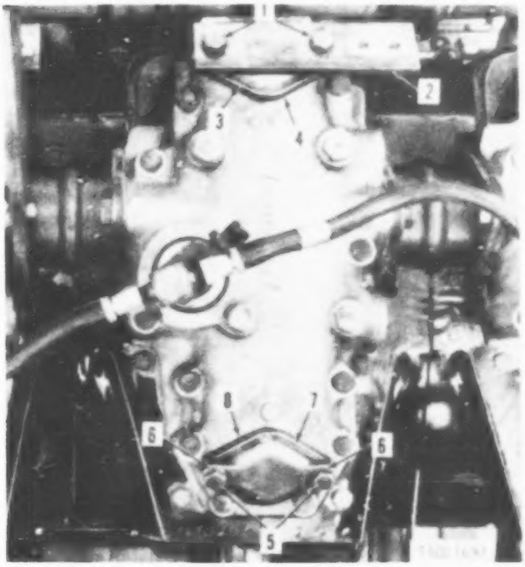
(1) Remove cooling fan vanes, cooling fans, engine upper covers, cooling fan shroud and fuel injector tubes. Refer to paragraph 2-21*a*.

(2) Remove oil coolers. Refer to paragraph 2-27*a*.

(3) Remove two self-locking bolts (1, fig. 2-151) support (2), and access cover (3). Remove and discard gasket (4). Remove two machine bolts (5) and two flat washers (6) and remove access cover (7). Remove and discard gasket (8).

NOTE

All of the valve adjusting screw access covers are removed or installed in the same manner.



1 Self-locking bolt
2 Support
3 Access cover
4 Gasket
5 Machine bolt
6 Flat washer
7 Access cover
8 Gasket

Figure 2-151. Removing or installing valve adjusting screw access cover.

NOTE

Before checking or adjusting exhaust and/or intake valve clearance, make sure both valves are closed on the cylinder being checked. Turn crankshaft as shown in figures 2-42 or 2-42.1 until valves are closed and camshaft lobes are in the position shown in figure 2-152.

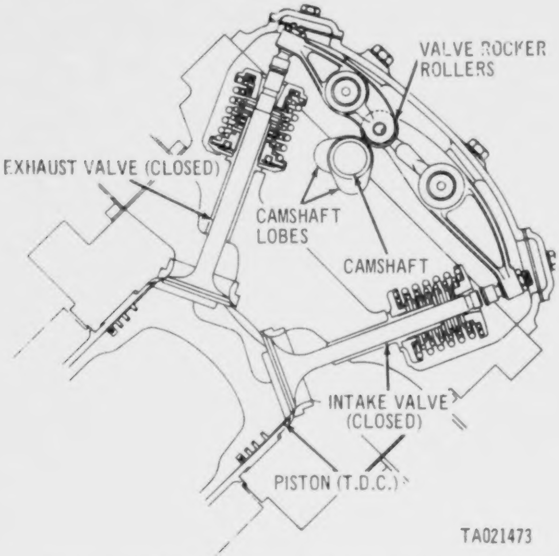


Figure 2-152. Position of camshaft lobes with intake and exhaust valves closed.

(4) Loosen exhaust valve adjusting screw lock nut (fig. 2-153). Turn valve adjusting screw until clearance between screw pad and valve stem is 0.025 inch, using thickness gage blade Part Number 10882616. Torque tighten lock nut to 175 pound-inches after correct adjustment is made. Make certain setting has not changed after tightening lock nut.

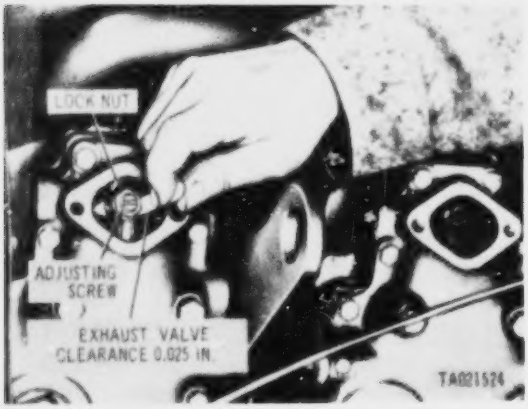


Figure 2-153. Setting exhaust valve clearance.

(5) Loosen intake valve adjusting screw lock nut (fig. 2-154). Turn valve adjusting screw until clearance between screw pad and valve stem is 0.010 inch, using thickness gage blade part number 10882115. Torque tighten nut to 175 pound-inches after correct adjustment is made.

b. Assembly.

(1) Install intake valve adjusting screw access cover (7, fig. 2-151) using new gasket (8) with two bolts (5) and flat washers (6). Install exhaust valve adjusting screw access cover (3) using new gasket (4). Install support (2) and secure with self-locking bolts (1).

(2) Install oil coolers, injector pump tubes, cooling fan shroud, engine upper covers, cooling fans and cooling fan vanes, refer to paragraph 2-27b and paragraph 2-21*b*.

DJUSTING SCREW
LOCK NUT
NOTE: INTAKE VALVE CLEARANCE 0.010 IN.
TA021453

Figure 2-154. Setting intake valve clearance.

2-53. Checking !ntake and Exhaust Valve Timing

a. General. Valve timing is checked with cylinder No. 6R and 6L intake valve clearance set at 0.100 inch. The flywheel is stamped (fig. 2-155) with timing marks "6R INT CLOSE 0.100 CLR" for timing the right camshaft with the crankshaft, and makred "6L INT CLOSE 0.100 CLR" for timing the left camshaft with the crankshaft. For instructional purposes the timing of the right camshaft is described. Right and left camshaft timing is identical.

b. Disassembly. Remove three capscrews (fig. 2-156), and remove timing access cover. Remove two bolts and flat washers attaching intake valve adjusting screw access cover. Remove cover and gasket. Discard gasket.

c. Positioning Camshaft.

(1) Turn crankshaft on Model AVDS-1790-2C and AVDS-1790-2D engines using splined wrench as shown in figure 2-42.

(1.1) Turn crankshaft on Model AVDS-1790-2DR engine using improvised turning tool as shown in figure 2-42.1.

(2) Loosen timing adjusting screw lock nut (fig.

best copy available

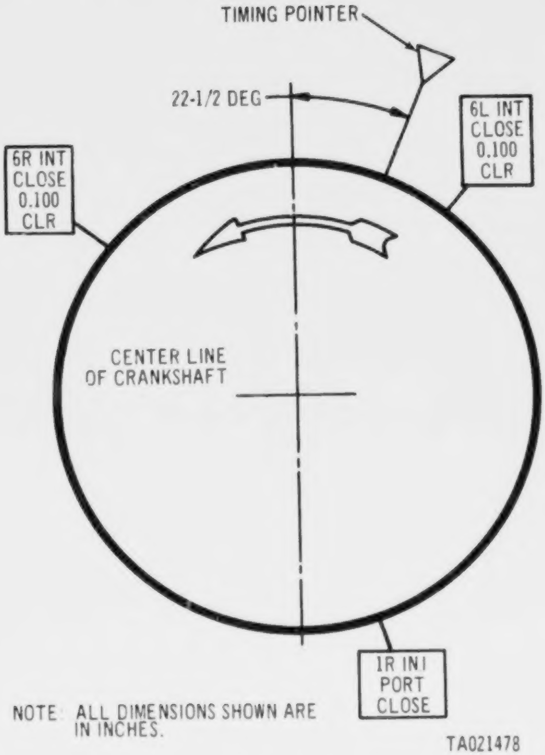

TIMING POINTER
22-1/2 DEG
6R INT CLOSE 0.100 CLR
6L INT CLOSE 0.100 CLR
CENTER LINE OF CRANKSHAFT
1R INT PORT CLOSE
NOTE: ALL DIMENSIONS SHOWN ARE IN INCHES.
TA021478

Figure 2-155. Flywheel timing mark locations.

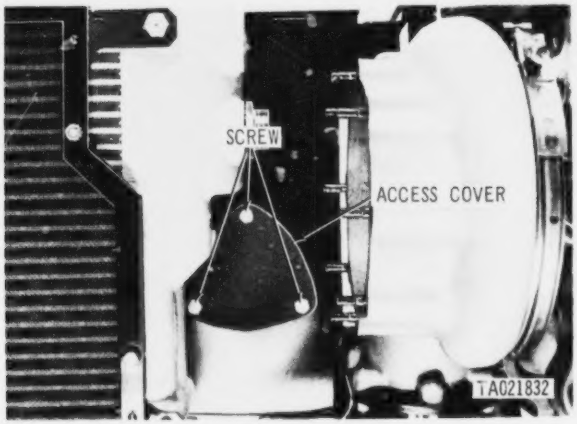

SCREW
ACCESS COVER
TA021832

Figure 2-156. Removing or installing valve timing access cover.

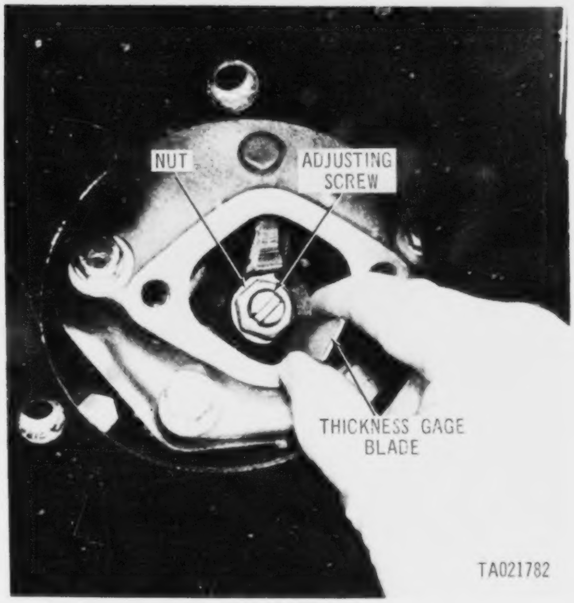

NUT
ADJUSTING SCREW
THICKNESS GAGE BLADE
TA021782

Figure 2-157. Setting intake valve clearance for cylinder 6R.

2-157). Turn valve adjusting screw and set valve clearance to 0.100 inch, using thickness gage blade part number 10882617. Gage blade must move through clerance with a slight drag. Torque tighten lock nut to 175 pound-inches after setting clearance. Check clearance to make certain setting has not changed.

d. Checking Valve Timing. Turn flywheel counterclockwise, viewed from rear, until pad on valve adjusting screw is just free of the valve stem (intake valve has just closed, fig. 2-158). In this position the flywheel mark "6R INT CLOSE 0.100 CLR" should be alined with pointer (fig. 2-159). If flywheel marks are not alined with pointer within 1/4 inch at the time the adjusting screw pad becomes free of valve stem, it will be necessary to

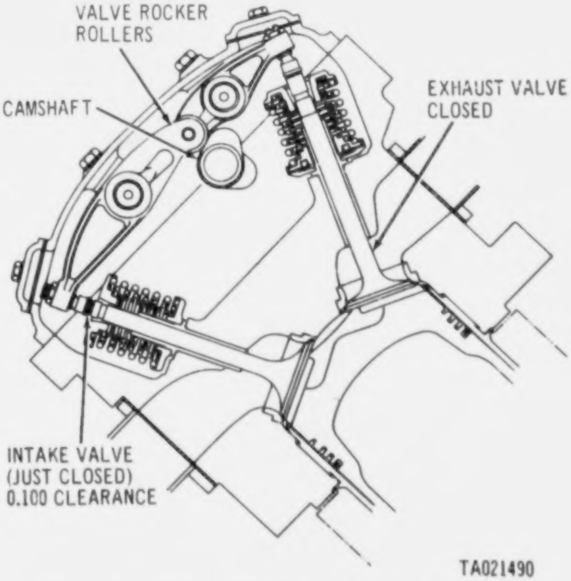

VALVE ROCKER ROLLERS
CAMSHAFT
EXHAUST VALVE CLOSED
INTAKE VALVE (JUST CLOSED) 0.100 CLEARANCE
TA021490

Figure 2-158. Cross section of cylinder 6R showing position of camshaft lobes for valve timing.

remove camshaft drive shaft and reset valve timing. Valve timing may be reset following the instructions that follow in paragraph *e*.

*d.*1. *Checking Valve Timing.* Turn flywheel counterclockwise, viewed from rear, until pad on valve adjusting screw is just free of the valve stem (intake valve has just closed, fig. 2-158). In this position the flywheel mark "6R INT CLOSE 0.100 CLR" should be alined with timing mark (fig. 2-159.1). If flywheel marks are not alined with mark within 1/4 inch at the time the adjusting screw pad becomes free of valve stem, it will be necessary to remove camshaft drive shaft and reset valve timing. Valve timing may be reset following the instructions in paragraph *e*. below.

e. Special Timing Instructions.

(1) Remove six capscrews, flat washers and loop clamp (fig. 2-160) attaching camshaft gear housing cover. Remove cover and gasket. Discard gasket.

(2) Remove retaining ring (fig. 2-161) and camshaft drive gearshaft plug with mechanical puller Part No. 8761297 (fig. 2-162). Remove camshaft drive shaft using mechanical puller Part No. 8761297 (fig. 2-163).

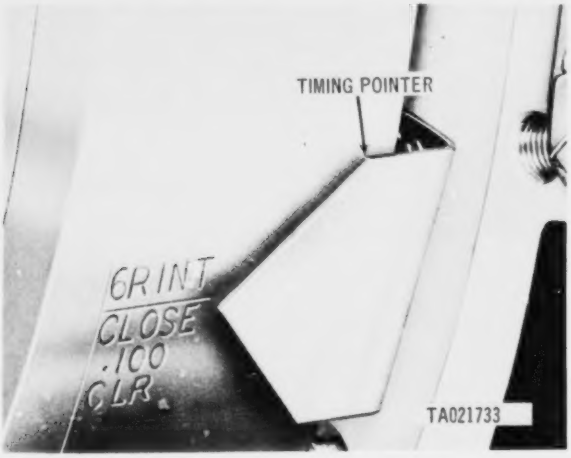


Figure 2-159. Flywheel timing marks alined with pointer for valve timing – right bank of cylinders, model AVDS-1790-2C and AVDS-1790-2D engines.

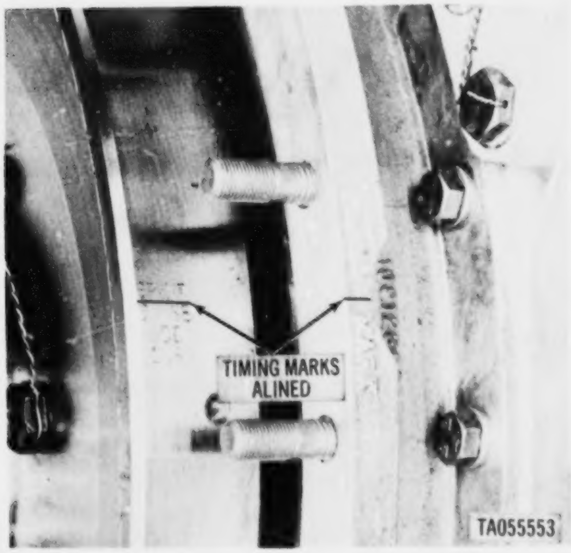


Figure 2-159.1. Flywheel timing mark alined for valve timing – right bank of cylinders, model AVDS-1790-2DR engine.

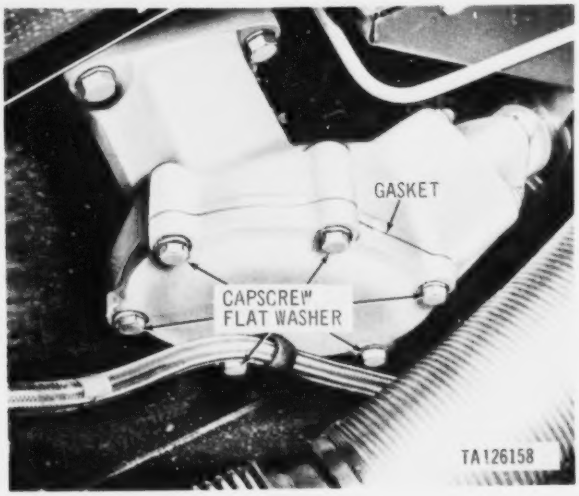


Figure 2-160. Removing or installing camshaft gear housing cover.

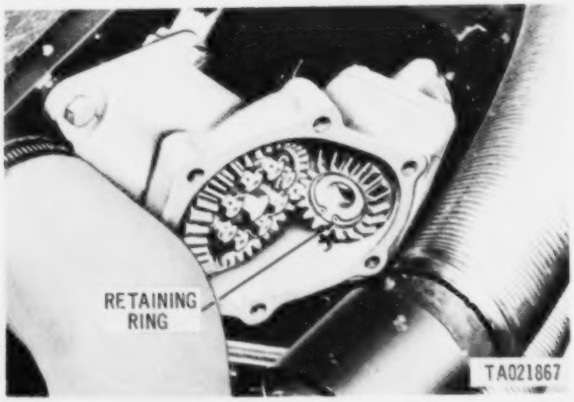


Figure 2-161. Removing or installing camshaft drive gearshaft plug retaining ring.

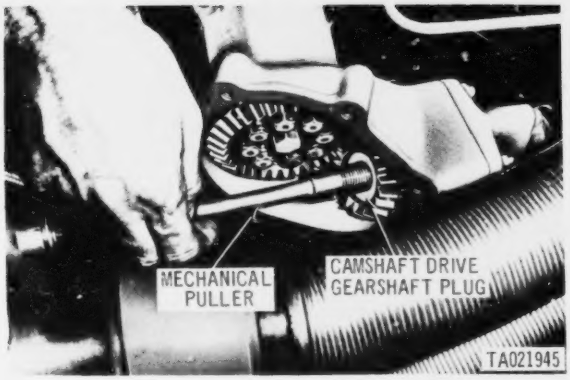


Figure 2-162. Removing or installing camshaft drive gearshaft plug.

NOTE

It may be necessary to repeat the operation in the following paragraph several times before mating splines are found. Do not force the drive shaft. The drive shaft is machined with a 24 tooth spline on the inner end and a 28 tooth spline on the outer end. This difference in number of splines makes it possible to index the drive shaft so it will engage the splines of the drive gearshaft and splines of the camshaft drive bevel gearshaft simultaneously without changing the relationship of the camshaft and crankshaft. An accurate setting is then provided.

(3) With cylinder 6R intake valve set at the just closing point (fig. 2-158), turn flywheel approximately 1/8 of a turn (or 45 degrees) clockwise (viewed at flywheel end) to remove backlash in gear train. Turn flywheel counterclockwise until the flywheel timing mark is alined with the timing pointer on Model AVDS-1790-2C and AVDS-1790-2D engines (fig. 2-159), or the flywheel timing mark is alined with the timing mark on the transmission adapter on Model AVDS-1790-2DR engines (fig. 2-159.1). Install camshaft drive shaft (fig. 2-163) using mechanical puller, Part No. 8761297, and mate splines of drive shaft with splines on drive gearshaft and with splines on camshaft drive bevel gearshaft. When splines of drive shaft will not enter splines of camshaft drive bevel gearshaft, withdraw drive shaft and turn slightly before attempting insertion. Recheck valve timing (paragraph d. above). Install camshaft drive gearshaft plug, retaining ring and camshaft gear housing cover using new gasket.

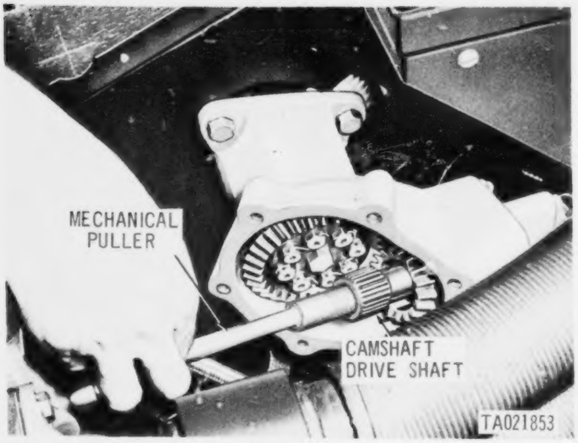


Figure 2-163. Removing or installing camshaft drive shaft using mechanical puller.

(4) Reset cylinder No. 6R (and/or 6L) intake valve clearance to 0.010 inch clearance (fig. 2-154).

f. Assembly. Install cover plate using new gasket, and secure with two bolts, flat washers, and loop clamp. Install timing access cover (fig. 2-156) and secure with three capscrews.

CHAPTER 3
REPAIR INSTRUCTIONS

Section I. PREPARATION OF ENGINE FOR DISASSEMBLY

3-1. General

This section covers the preparation of the engine for disassembly. Refer to the pertinent TM's covering the removal of powerpack from the vehicle and separation of the transmission from the engine.

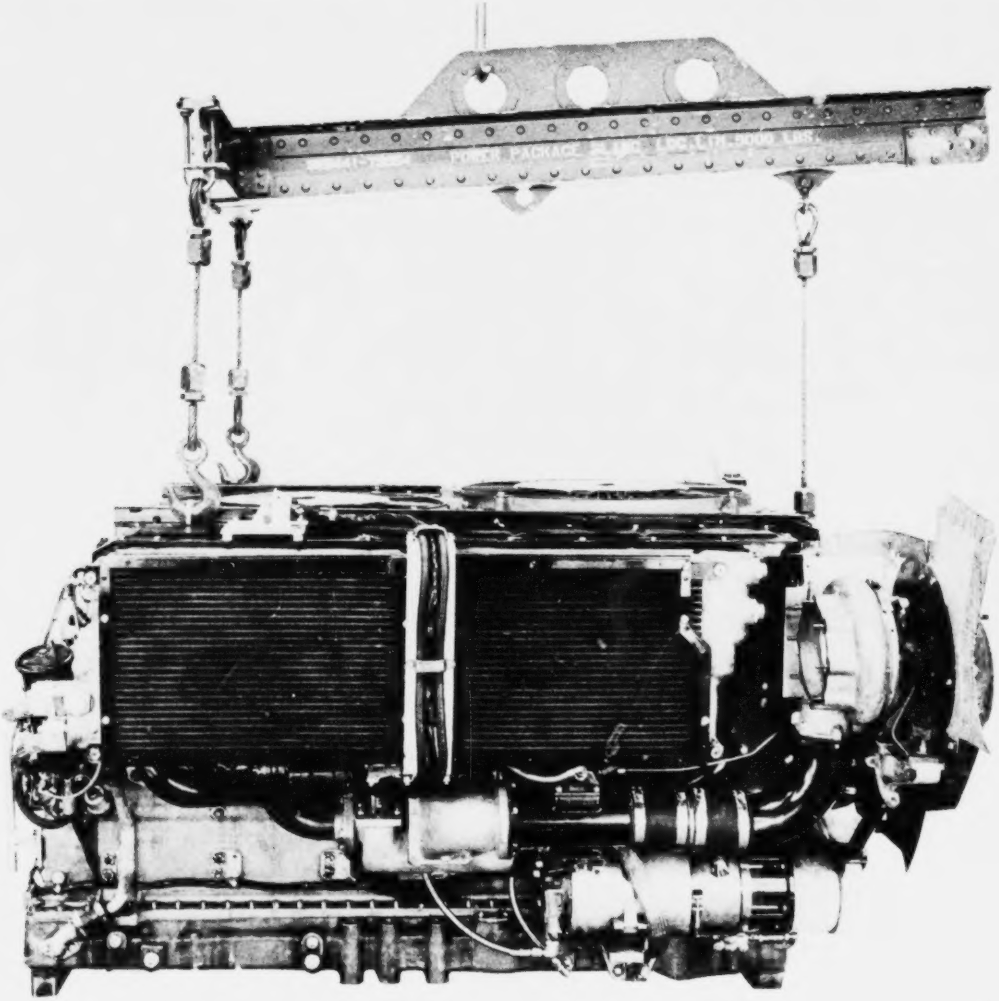
3-2. Draining, Cleaning, and Preliminary Inspection

a. Lift engine using multiple sling part number 12257229 (fig. 3-1) and place engine on suitable blocks.

a.1. Lift Model AVDS-1790-2DR using engine lifting sling, part number 11671664, in a manner similar to paragraph *a*. above. However, the front of the engine is lifted at the crankshaft damper and filter housing lifting eyes.

b. Remove oil pan drain plug (fig. 3-2) and drain oil into a suitable container with approximately twenty gallon capacity.

c. Remove oil vent capscrew and seal washer (fig. 3-3). Remove and discard seal washer. Loosen oil drain valve six complete turns and allow oil to



TA021995

Figure 3-1. Lifting engine, model AVDS-1790-2C engine shown.

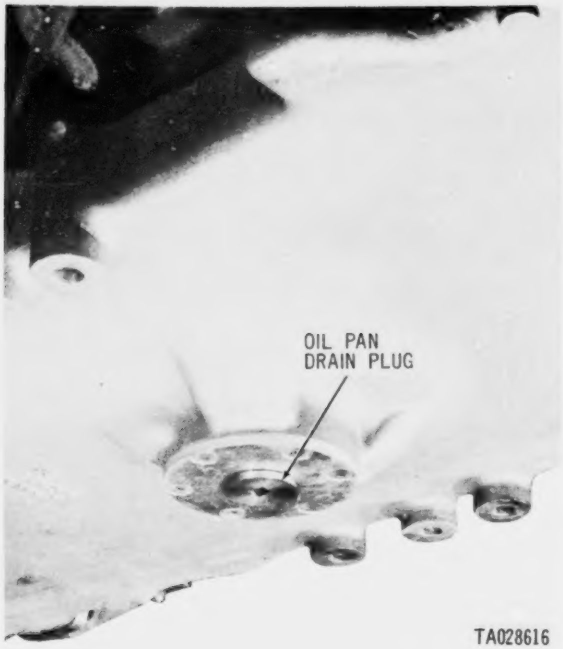


Figure 3-2. Removing drain plug.

drain at the oil pan drain plug opening. Do not loosen oil drain valve adapter.

d. After oil is drained from engine install oil vent capscrew in damper housing (fig. 3-3) and oil pan drain plug (fig. 3-2) in oil pan.

d.1. Remove oil sampling drain cock (fig. 3-3) on Model AVDS-1790-2DR only.

e. Close all openings on the engine with waterproof tape or suitable plugs and thoroughly clean all external parts and outer surfaces. Make sure no foreign material enters working parts of engine assembly. Wash engine using water under pressure to remove mud and dirt. Remove oil and grease using a stiff brush with dry cleaning solvent (PD-680).

f. After engine has been thoroughly drained and cleaned, inspect external portion of engine to determine leaks, broken or cracked areas, and missing parts.

g. Visually inspect external components for bent, broken, or other damaged condition, and mark areas to serve as a guide in repair or replacement of such parts.

3-3. Remove Engine Accessories

NOTE

To permit the installation of engine on mounting brackets and mounting engine on the maintenance stand, certain accessories must be removed.

a. Remove fuel supply pump, starter, generator, turbosupercharger, wiring harness, and power takeoff drive housing as outlined in paragraphs 2-17, 2-17.1, 2-18, 2-19, 2-20, 2-20.1, 2-49, and 2-49.1 as applicable.

NOTE

Model AVDS-1790-2DR is not equipped with a wiring harness.

b. Remove generator rear oil drain hose (fig. 3-4), elbow, check valve and nipple. Separate parts.

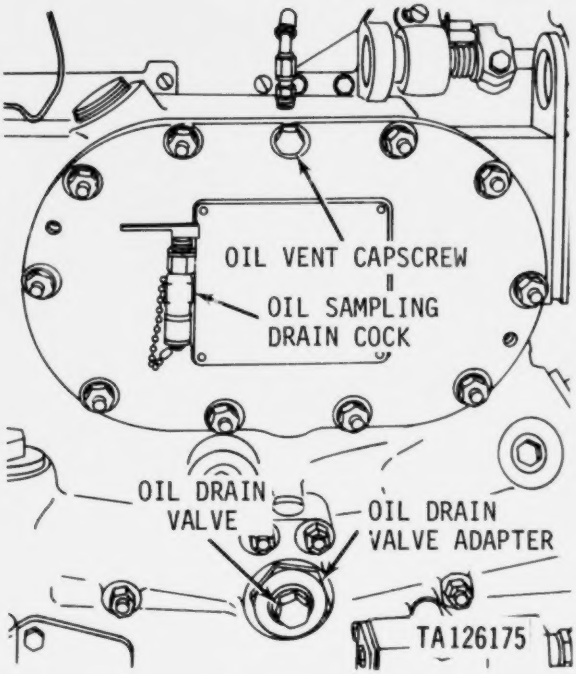


Figure 3-3. Draining oil filter housing and oil coolers.

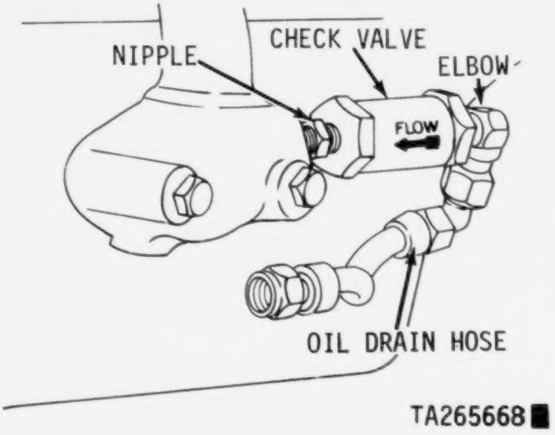


Figure 3-4. Removing front and rear drain tubes and check valve.

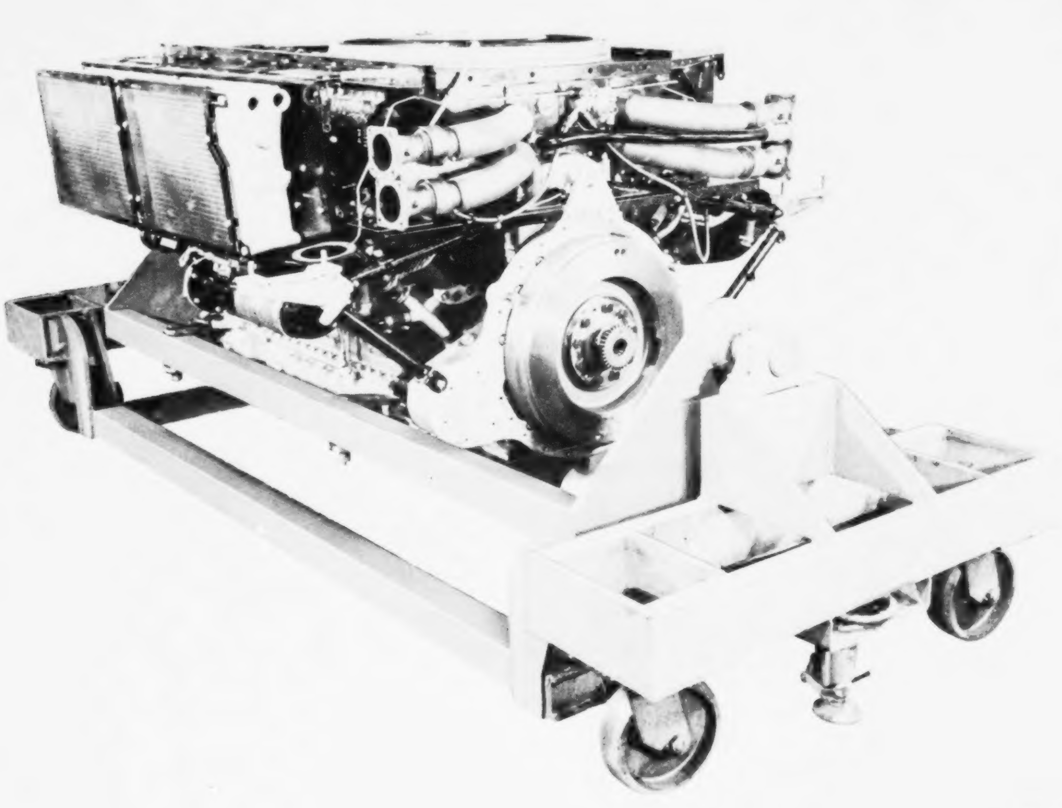
Section II. INSTALLATION OF ENGINE ON OVERHAUL STAND AND DISASSEMBLY INTO SUBASSEMBLIES

3-4. General

This section covers the installation of engine on overhaul stand and disassembly of engine into subassemblies. Components are grouped together in proper disassembly order. For removal and disassembly procedures for the Model AVDS-1790-2CA and Model AVDS-1790-2DA, clean air package, refer to Chapter 4.

3-5. Installing Engine on Overhaul Stand

Secure engine to maintenance and overhaul stand part number 10912260 (fig. 3-5) with four 5/8 x 1-1/2 inch hexagon head bolts and 5/8 inch flat washers furnished with stand.



TA021937

Figure 3-5. Engine on maintenance and overhaul stand.

3-5.1. Smoke Generating System Fuel Tubes and Shut-off Valve

a. Disconnect fuel hose from fuel/water separator tee (fig. 3-5.1). Remove fuel hose (1, fig. 3-5.2). Disconnect fuel outlet tube (2). Remove two assembled washer bolts (3) and remove fuel shut-off valve and bracket. Remove two capscrews and self-locking nuts (4) and separate shut-off valve from bracket.

b. Remove three assembled washer bolts from left upper covers that retain smoke generating fuel tube loop clamps (fig. 3-5.3). On Model

AVDS-1790-2DR remove four assembled washer bolts and loop clamps.

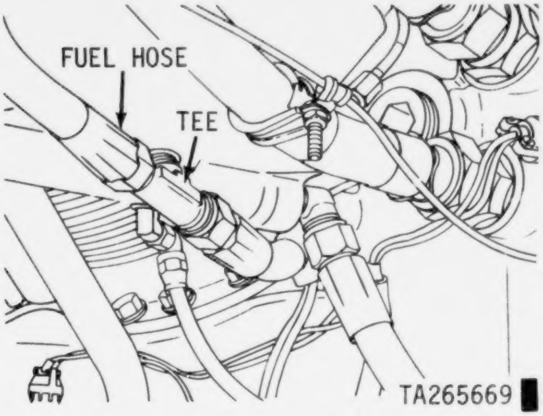

FUEL HOSE
TEE
TA265669

Figure 3-5.1. Removing or installing smoke generating system fuel hose.

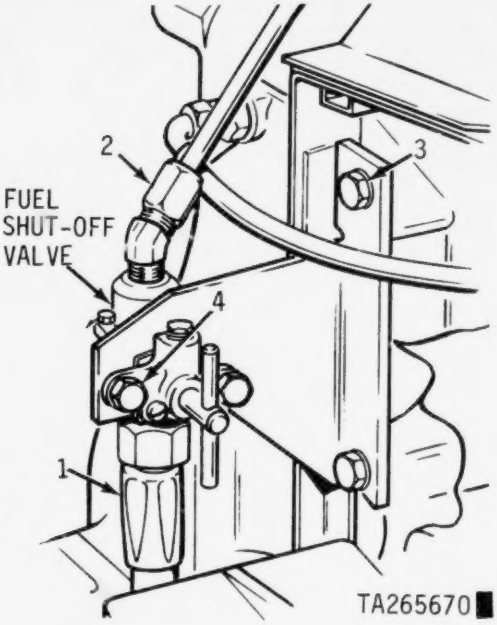

2
3
FUEL SHUT-OFF VALVE
4
1
TA265670

Figure 3-5.2. Removing or installing smoke generating system shut-off valve.

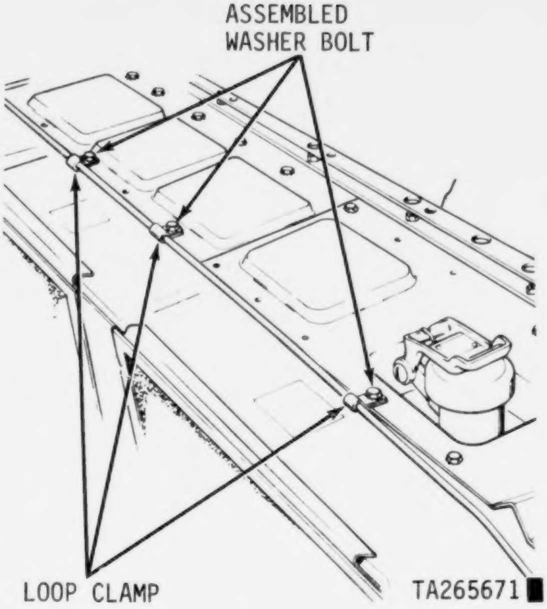

ASSEMBLED WASHER BOLT
LOOP CLAMP
TA265671

Figure 3-5.3. Removing or installing smoke generating system fuel tube loop clamps.

c. At left rear of engine remove solenoid valve inlet tube nut from outlet of bulkhead elbow (fig. 3-5.4). Remove retaining nut, lockwasher and flat washer from elbow, remove elbow and fuel tube assembly.

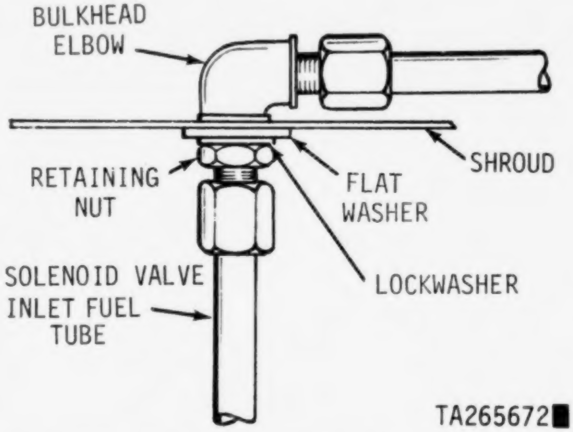
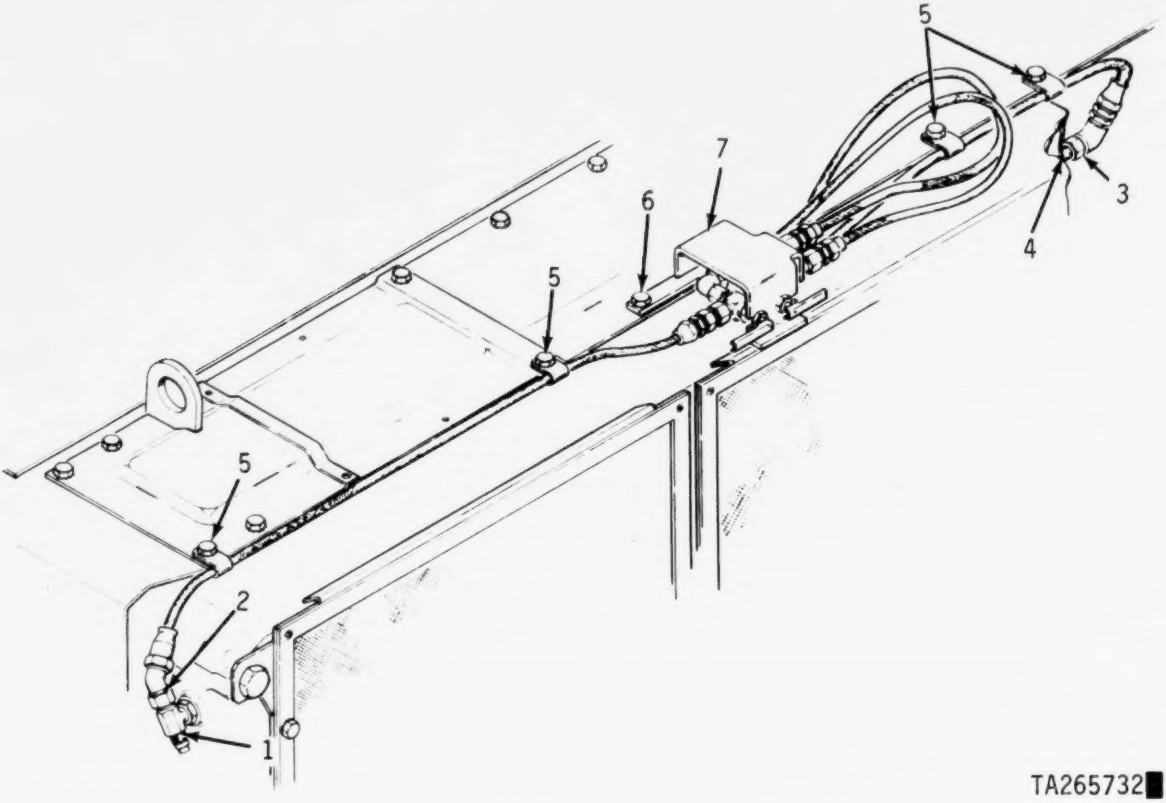

BULKHEAD ELBOW
SHROUD
RETAINING NUT
FLAT WASHER
SOLENOID VALVE INLET FUEL TUBE
LOCKWASHER
TA265672

Figure 3-5.4. Removing or installing smoke generating fuel inlet line at bulkhead elbow.

3-5.2. Oil Sampling Systems Hoses and Valves

Disconnect coupling nut of engine oil inlet line (2, fig. 3-5.5) from cooler tee (1), and coupling nut of transmission oil inlet line (3) from adapter (4). Remove four assembled washer bolts and loop clamps (5) from right front and rear upper covers. Remove two assembled washer bolts (6) and remove sampling valves mounting bracket (7). Remove oil sampling system as an assembly.



1 Tee
2 Engine oil inlet line
3 Transmission oil inlet line
4 Adapter
5 Assembled washer bolt and loop clamp
6 Assembled washer bolt
7 Mounting bracket

Figure 3-5.5. Removing or installing oil sampling system

Figure 3-5.6. Deleted

3-6. Cooling Fan Vanes and Cooling Fans

a. Remove two machine bolts and lockwashers (1, fig. 3-6) and two capscrews and lockwashers (2) and remove cooling fan vane (3) from front fan housing (4). Remove two machine bolts and lockwashers (5) and two capscrews and lockwashers (6) and remove cooling fan vane (3) from rear fan housing (7). Remove 12 self-locking nuts and lockwashers (8) attaching cooling fan shroud to top frame. Open oil indicator tube cap (9) and remove oil gage indicator rod. Remove 11 assembled washer bolts (10) and remove left rear upper cover (11). Remove left front upper cover (12), with oil indicator tube attached. Remove and discard two preformed packings from tube cap neck. Remove 17 assembled washer bolts (13) and remove right rear upper cover (14) and right front upper cover (15).

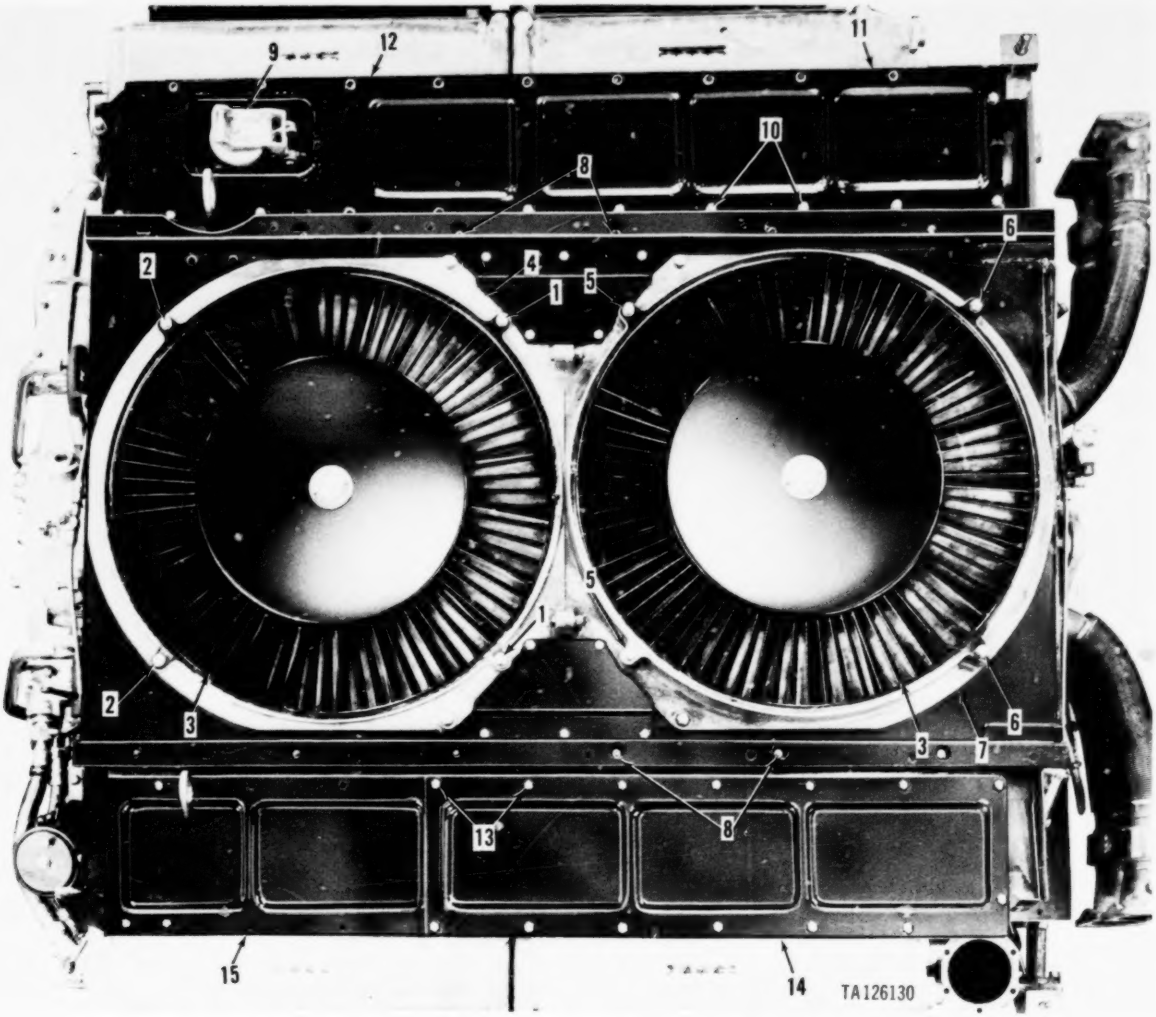
a.1. Remove four-capscrews and lockwashers (1, fig. 3-6.1) and four machine bolts and lockwashers (2) and remove the front and rear cooling fan vanes (3). Open oil indicator tube cap (4) and remove oil gage indicator rod. Remove 12 self-locking nuts and flat washers (5) and four assembled washer bolts (6) attaching cooling fan shroud to top frame. Remove assembled washer bolt (7) and remove retaining strap (8). Remove five assembled washer bolts (9) and lift left front upper cover assembly (10) with oil level indicator tube cap attached, from the oil level indicator tube assembly. Remove and discard the two preformed packings from the tube cap neck. Remove five assembled washer bolts (11) and remove the left rear upper cover (12). Remove five assembled washer bolts (13) and remove cover adapter (14). Remove 10 assembled washer bolts (15) and remove right front upper cover (16). Remove 12 assembled washer bolts (17) and remove right rear upper cover (18).

b. Remove cotter pin, slotted nut and flat washer (fig. 3-7) and discard cotter pin. Remove front cooling fan and hub assembly from vertical drive shaft. Remove rear cooling fan and hub assembly in the same manner.

3-7. Cooling Fan Shroud

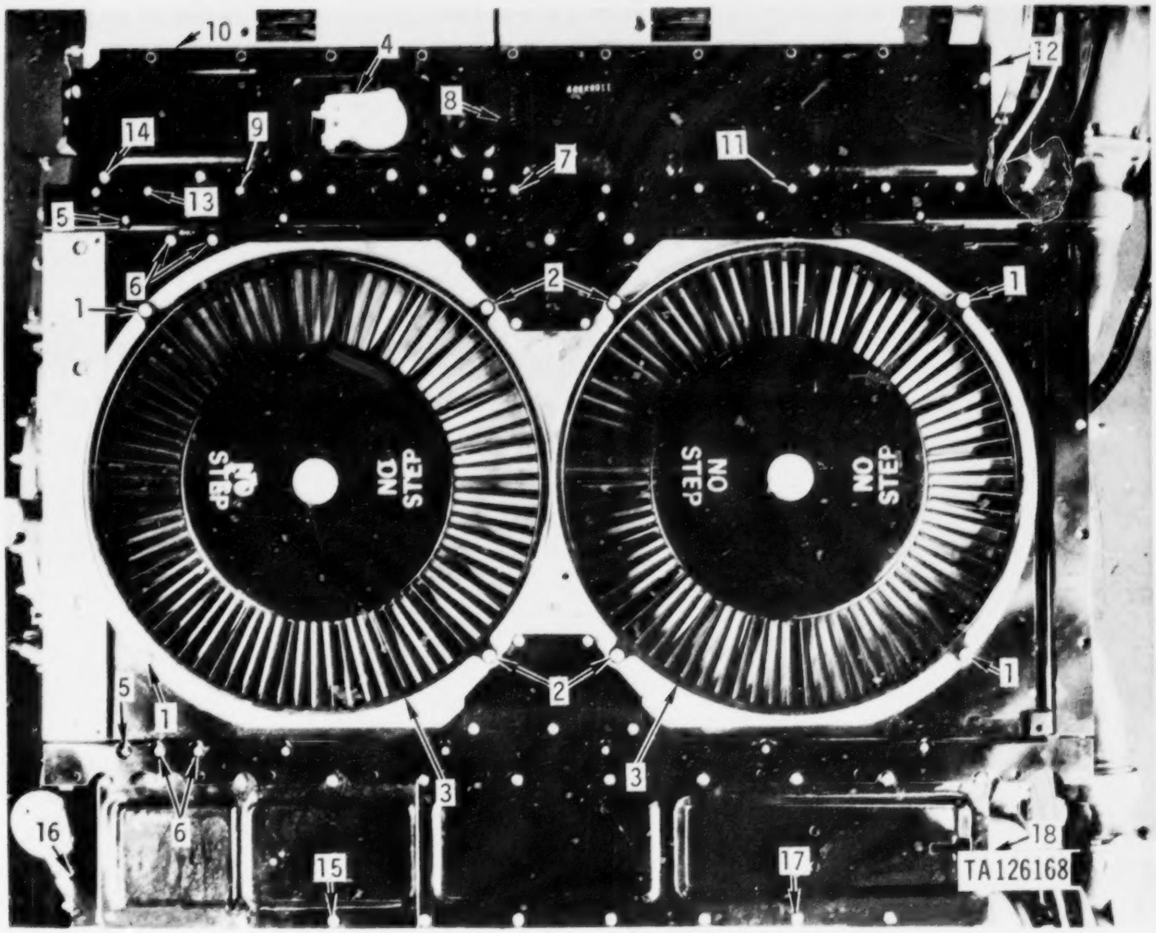
a. Remove five assembled washer bolts (fig. 3-8) attaching cooling fan shroud and two oil cooler vent line clamps to right and left front shroud.

b. Remove four assembled washer bolts, flat washers and hexagon nuts (1, fig. 3-9) attaching rear shrouds and cylinder head fuel return tube clamps to cooling fan shroud. Remove three assembled washer bolts (2) and remove cooling fan shroud.



1 Machine bolt and lockwasher
2 Capscrew and lockwasher
3 Cooling fan vane
4 Front fan housing
5 Machine bolt and lockwasher
6 Capscrew and lockwasher
7 Rear fan housing
8 Self-locking nut and flat washer
9 Oil indicator tube cap
10 Assembled washer bolt
11 Left rear upper cover
12 Left front upper cover
13 Assembled washer bolt
14 Right rear upper cover
15 Right front upper cover

Figure 3-6. Removing or installing cooling fan vanes and upper covers, model AVDS-1790-2C and AVDS-1790-2D engines.



1 Capscrew and lockwasher	10 Left front upper cover assembly
2 Machine bolt and lockwasher	11 Assembled washer bolt
3 Cooling fan vane	12 Left rear upper cover
4 Oil indicator tube cap	13 Assembled washer bolt
5 Self-locking nut and flat washer	14 Cover adapter
6 Assembled washer bolt	15 Assembled washer bolt
7 Assembled washer bolt	16 Right front upper cover
8 Retaining strap	17 Assembled washer bolt
9 Assembled washer bolt	18 Right rear upper cover

Figure 3-6.1. Removing or installing cooling fan vanes and upper covers, model AVDS-1790-2DR engine.

b.1. Remove four self-locking nuts securing the fuel return tube clamps to the inside of the shroud, and remove four assembled washer bolts (1, fig. 3-9.1). Remove the three remaining assembled washer bolts (2) securing the cooling fan shroud to the rear shrouds. Remove cooling fan shroud and fan housings.

3-8. Installation Guides and Time Totalizing Meter (Models AVDS-1790-2C and AVDS-1790-2D)

a. Remove four self-locking nuts (1, fig. 3-10) and two self-locking nuts and flat washers (2) and remove right installation guide (3) and time totalizing meter (4). Install two lower self-locking nuts (1) securing the right lifting eye (5) to the damper housing.

b. Remove two self-locking nuts securing the left installation guide (6), the fuel supply line cushioned clamp, and left lifting eye (7) to the damper housing (8). Remove two self-locking nuts and flat washers (9) securing the guide to the damper housing and remove guide.

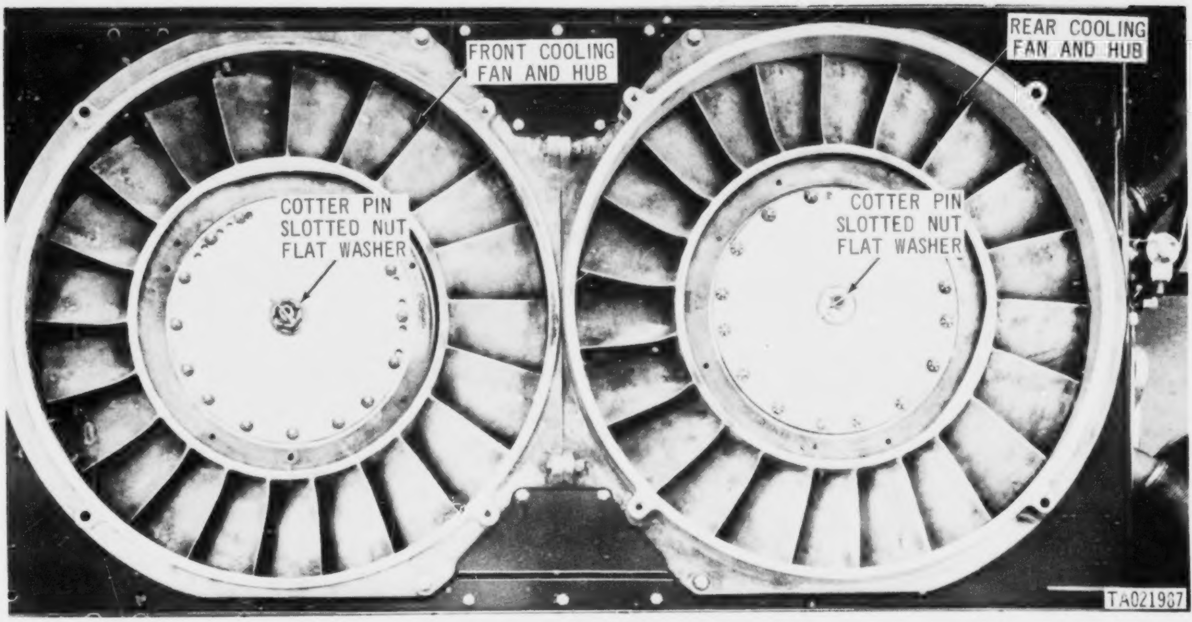

FRONT COOLING FAN AND HUB
REAR COOLING FAN AND HUB
COTTER PIN SLOTTED NUT FLAT WASHER
COTTER PIN SLOTTED NUT FLAT WASHER
TA021907

Figure 3-7. Removing or installing cooling fans.

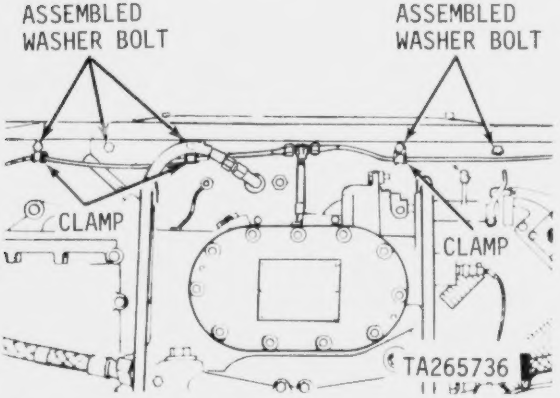
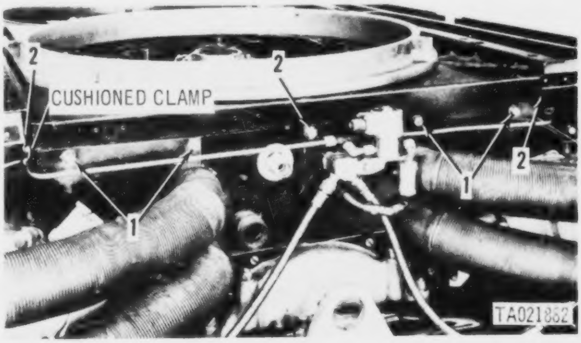

ASSEMBLED WASHER BOLT
ASSEMBLED WASHER BOLT
CLAMP
CLAMP
TA265736

Figure 3-8. Disconnecting or connecting front end of cooling fan shroud.


2
2
CUSHIONED CLAMP
1
1
2
TA021862

1 Assembled washer bolt, flat washer and hexagon nut
2 Assembled washer bolt

Figure 3-9. Removing or installing cooling fan shroud, model AVDS-1790-2C and AVDS-1790-2D engines.

3-8.1. Time Totalizing Meter (Model AVDS-1790-2DR)

a. Disconnect electrical lead (1, fig. 3-10.1) from time totalizing meter and generator. Remove two capscrews and lockwashers (2) and remove cushioned clamps.

b. Remove four self-locking nuts (3) and remove ground lead (4), spacer (5), time totalizing meter (6), and electrical lead (1).

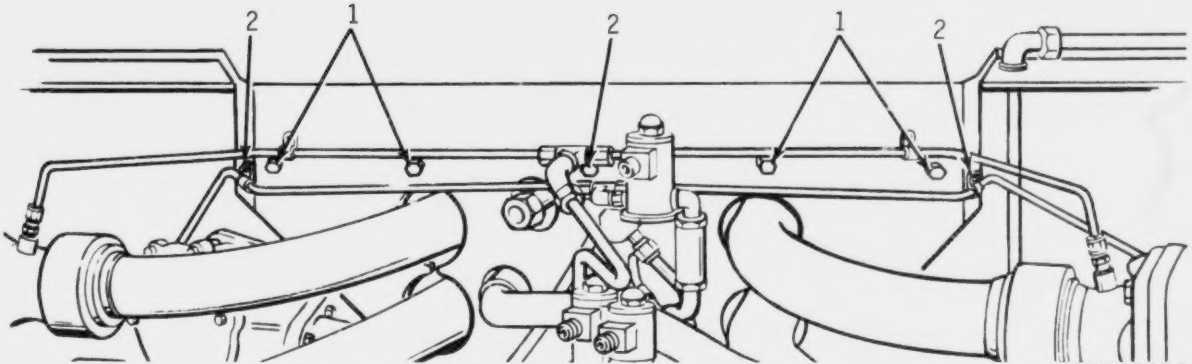
c. Install the lower two self-locking nuts (3) to secure the lifting eye to the damper housing.

d. Remove two upper self-locking nuts on left damper housing lifting eye and remove spacer.

3-9. Oil Coolers and Support Frames

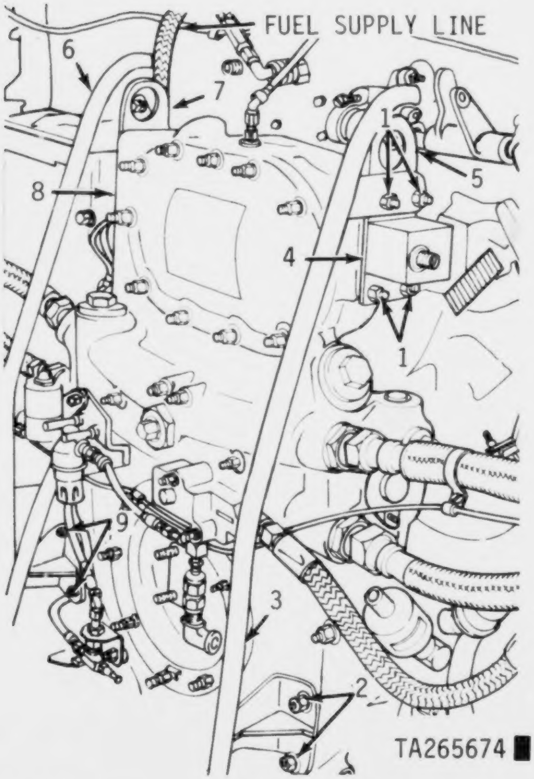
a. Oil Coolers.

(1) Remove two assembled washer bolts (1, fig. 3-11) securing oil cooler vent line clamps to shroud. Disconnect oil cooler vent lines (2) at oil cooler vent adapter (3), oil cooler vent tee (4) and at damper housing vent adapter (5) and remove vent lines and four cushioned clamps. Remove cushioned clamps from lines and disconnect lines from tee. Disconnect fuel filter constant bleed hose (6) at bulkhead union (7).



1 Assembled washer bolt and self-locking nut
2 Assembled washer bolt

Figure 3-9.1. Removing or installing cooling fan shroud, model AVDS-1790-2DR engine.

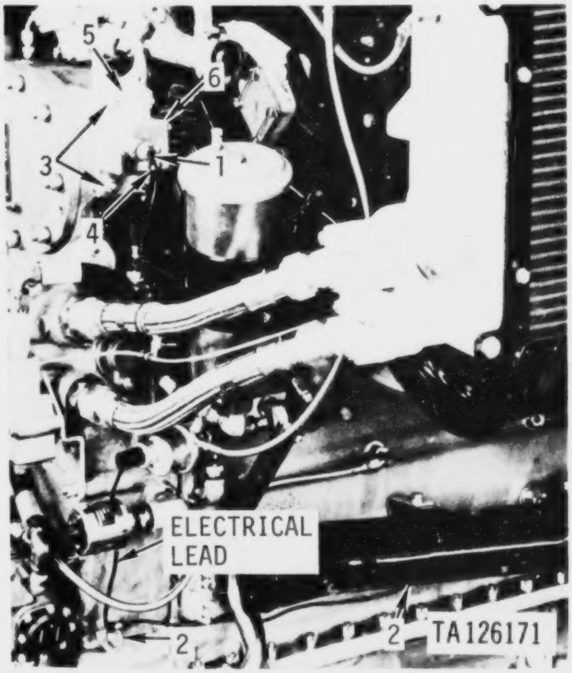


1 Self-locking nut
2 Self-locking nut and flat washer
3 Right installation guide
4 Time totalizing meter
5 Right lifting eye
6 Left installation guide
7 Left lifting eye
8 Damper housing
9 Self-locking nut and flat washer

Figure 3-10. Removing engine installation guides and time totalizing meter, model AVDS-1790-2C and AVDS-1790-2D engines.

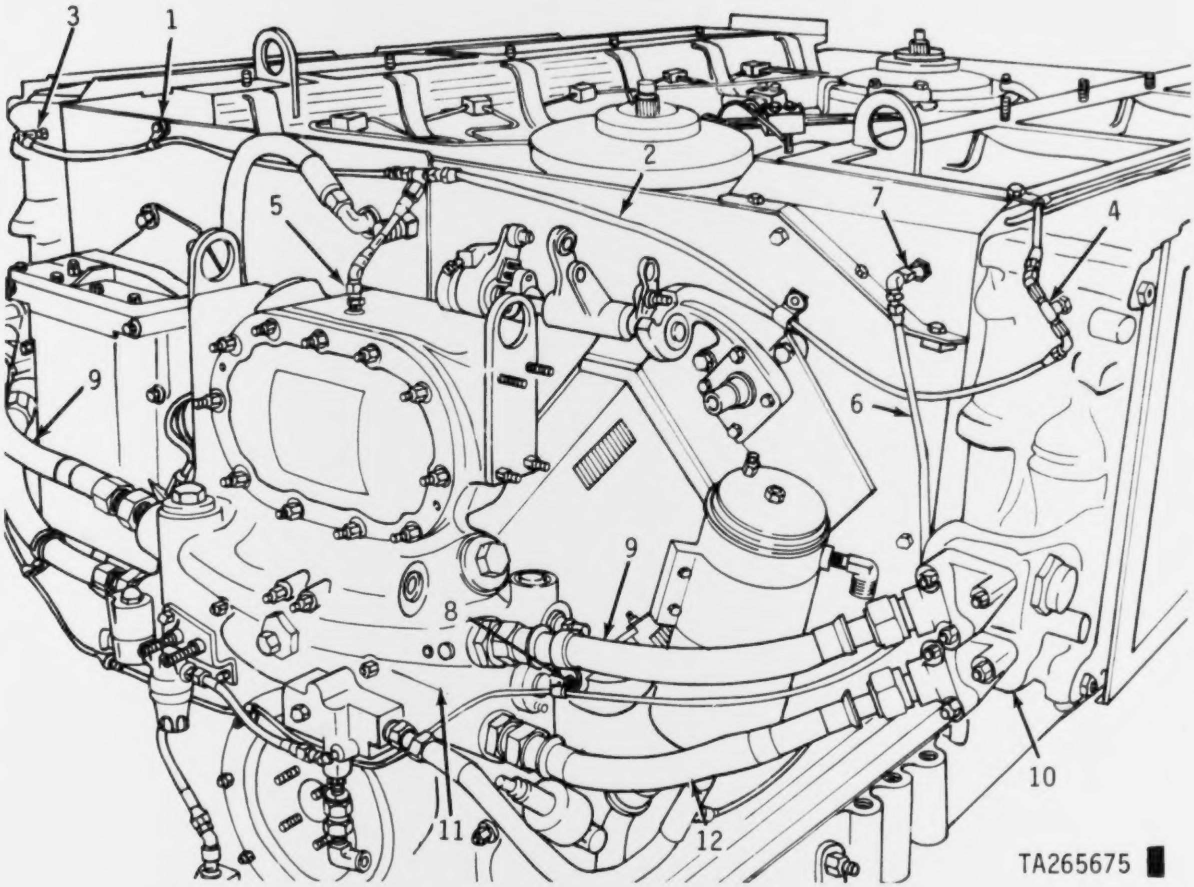
(2) Remove screw and self-locking nut (8) attaching each manifold heater fuel tube clamp to oil cooler hose clamp and remove clamps. Disconnect oil cooler outlet hoses (9) at oil coolers (10) and at damper housing (11) and remove hoses. Disconnect oil cooler oil inlet hoses (12) at oil coolers (10) and at damper housing (11) and remove hoses.

(3) Remove two assembled washer bolts and one flat washer (1, fig. 3-12) and remove transmission oil cooler screen (2). Remove four machine bolts (3) and remove engine oil cooler screen (4), damper end oil cooler screen bracket (5), center oil cooler screen bracket (6) and engine oil cooler (7) as an assembly from oil cooler support frame.



1 Electrical lead
2 Capscrew and lockwasher
3 Self-locking nut
4 Ground lead
5 Spacer
6 Time totalizing meter

Figure 3-10.1. Removing time totalizing meter, model AVDS-1790-2DR engine.

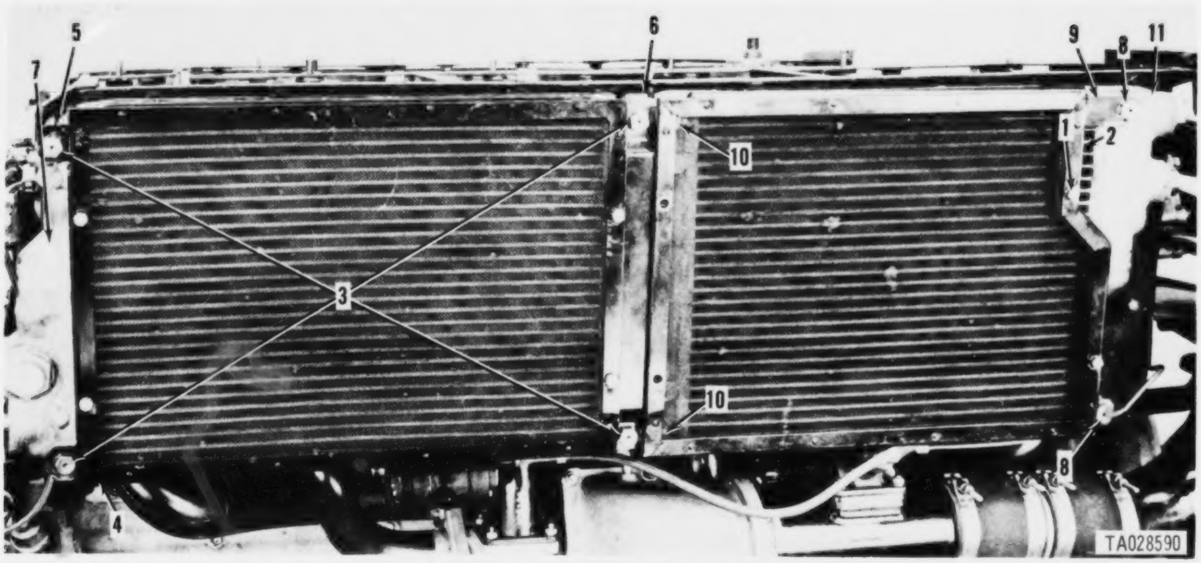


1	Assembled washer bolt	7	Bulkhead union
2	Oil cooler vent line	8	Machine screw and self-locking nut
3	Oil cooler vent adapter	9	Oil cooler oil outlet hose
4	Oil cooler vent tee	10	Oil cooler
5	Damper housing vent adapter	11	Damper housing
6	Constant bleed hose	12	Oil cooler oil inlet hose

Figure 3-11. Removing or installing oil cooler oil inlet, oil outlet and vent hoses.

(4) Remove two machine bolts (8) and remove transmission oil cooler screen bracket (9). Remove two machine bolts and flat washers (10) and remove transmission oil cooler (11) from oil cooler frame.

(5) Remove engine and transmission oil coolers on the left bank in the same manner.



1 Assembled washer bolt and flat washer	7 Engine oil cooler
2 Transmission oil cooler screen	8 Machine bolt
3 Machine bolt	9 Transmission oil cooler screen bracket
4 Engine oil cooler screen	10 Machine bolt and flat washer
5 Damper end oil cooler screen bracket	11 Transmission oil cooler
6 Center oil cooler screen bracket	

Figure 3-12. Removing or installing right engine and transmission oil coolers and screens.

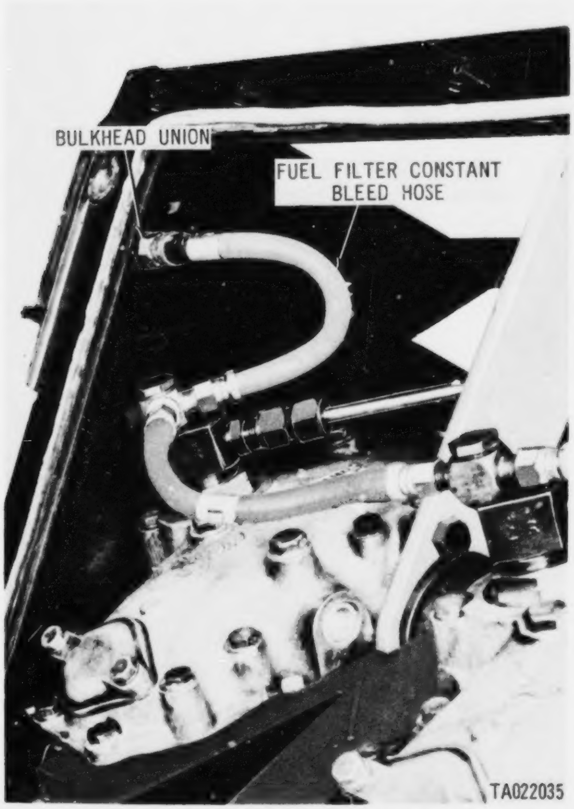


Figure 3-13. Removing or installing fuel filter constant bleed hose.

b. Right Oil Cooler Support Frame.

(1) Disconnect fuel filter constant bleed hose (fig. 3-13) from bulkhead union.

(2) Remove bulkhead union retainer nut and remove bulkhead union from shroud. Remove assembled washer bolt (fig. 3-14) and disconnect and remove fuel filter constant bleed hose from fuel filter. Remove cushioned clamp from hose. Remove one assembled washer bolt securing front shroud to oil cooler support frame.

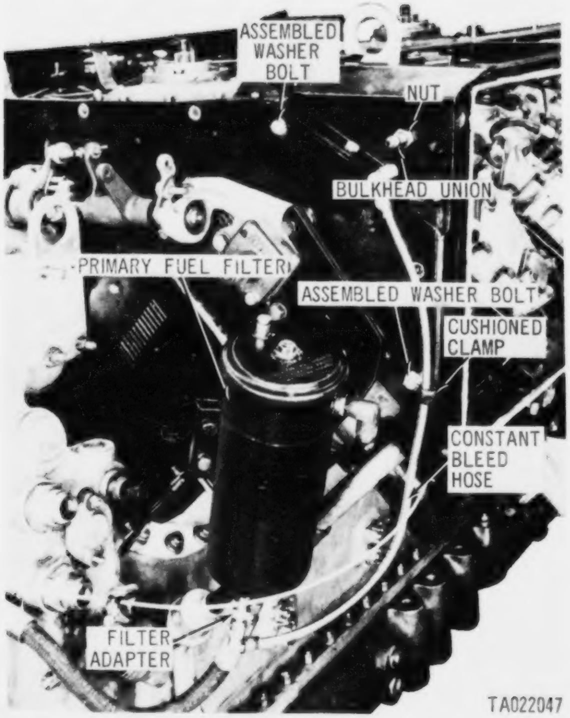

ASSEMBLED WASHER BOLT
NUT
BULKHEAD UNION
PRIMARY FUEL FILTER
ASSEMBLED WASHER BOLT
CUSHIONED CLAMP
CONSTANT BLEED HOSE
FILTER ADAPTER
TA022047

Figure 3-14. Disconnecting or connecting right front oil cooler support frame.

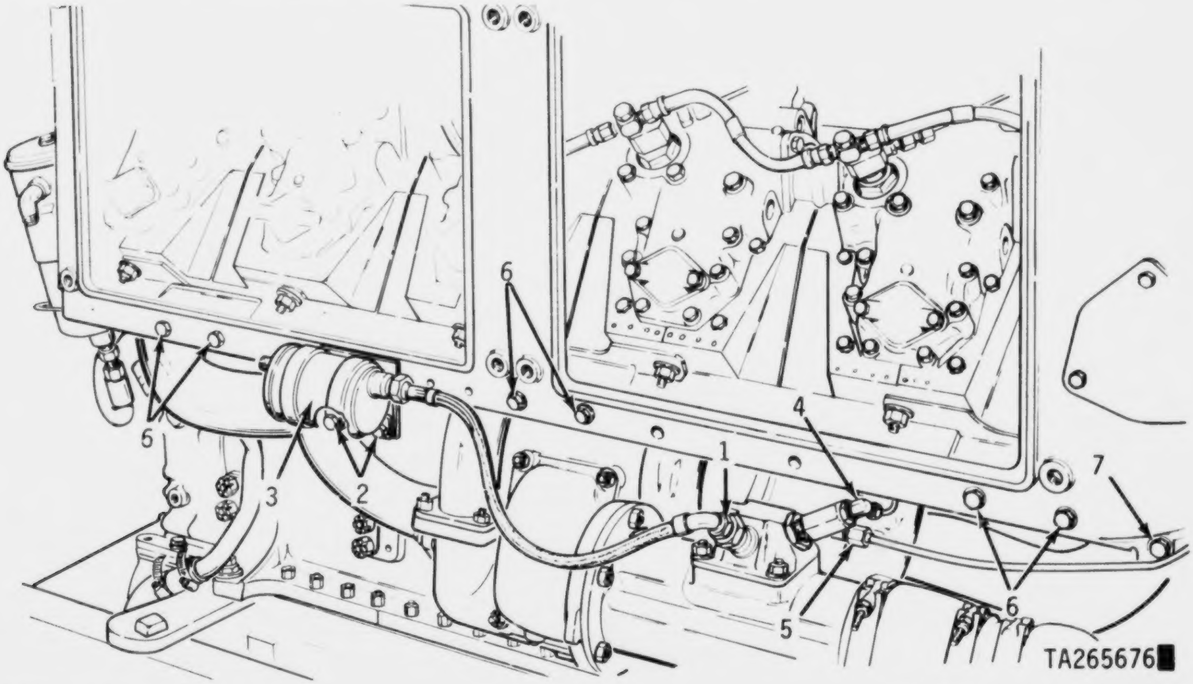
(3) Disconnect manifold heater spark plug electrical lead, (1, fig. 3-15) remove two capscrews and self-locking nuts (2) and remove ignition unit (3) with clamps and lead. Remove clamps and disconnect lead from ignition unit.

(4) Disconnect manifold air heater fuel inlet tube from nozzle inlet elbow (4). Disconnect manifold air heater fuel return tube (5). Remove six capscrews and self-locking nuts (6) securing oil cooler support frame. Remove screw and self-locking nut (7) securing support frame to turbosupercharger support bracket.

(5) Remove self-locking nut, machine bolt, grommet and two spacers (1, fig. 3-16) and remove turbosupercharger support bracket (2). Remove three assembled washer bolts (3) securing rear shroud to oil cooler support frame (4), and remove transmission upper shroud assembly (5) and support frame.

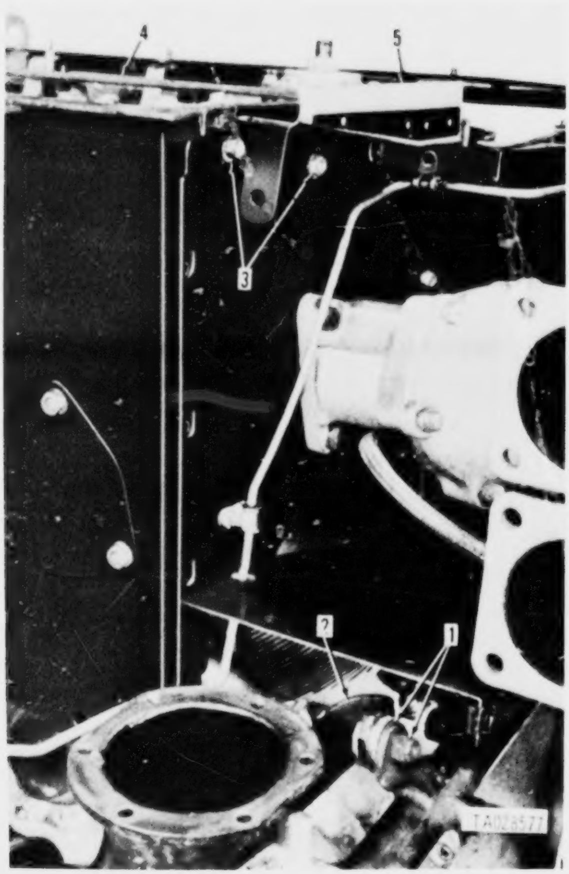
NOTE

Model AVDS-1790-2DR has five assembled washer bolts (3, fig. 3-16) securing rear shroud to the oil cooler frame, and is not equipped with a transmission upper shroud (5).


6
6
3
2
1
4
7
5
6
TA265676

1 Manifold heater spark plug electrical lead
2 Capscrew and self-locking nut
3 Ignition unit
4 Nozzle inlet elbow
5 Manifold heater fuel return tube
6 Capscrew and self-locking nut
7 Capscrew and self-locking nut

Figure 3-15. Disconnecting or connecting right side oil cooler support frame.



1 Machine bolt and self-locking nut
2 Turbosupercharger support bracket
3 Assembled washer bolt
4 Oil cooler support frame
5 Transmission upper shroud

Figure 3-16. Removing or installing right oil cooler support frame, and turbosupercharger support bracket.

c. Left Oil Cooler Support Frame.

(1) Remove three assembled washer bolts (fig. 3-17) securing front shroud to oil cooler support frame.

(2) Disconnect manifold heater spark plug electrical lead (1 fig. 3-18). Remove two capscrews and self-locking nuts (2) and remove ignition unit (3) with clamps and lead. Remove clamps and disconnect lead from ignition unit.

(3) Disconnect manifold heater fuel inlet tube from nozzle inlet elbow (4). Disconnect manifold air heater fuel return tube (5). Remove six capscrews and self-locking nuts (6) securing oil cooler support frame.

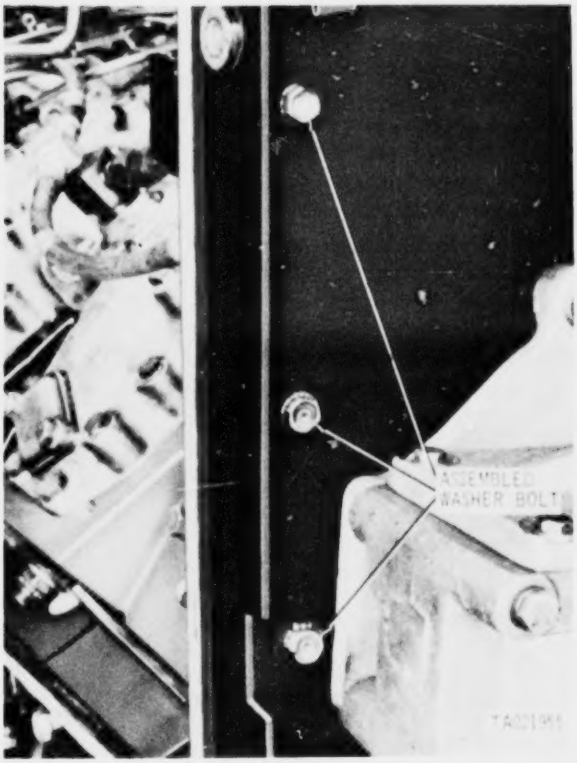


Figure 3-17. Disconnecting or connecting left front oil cooler support frame.

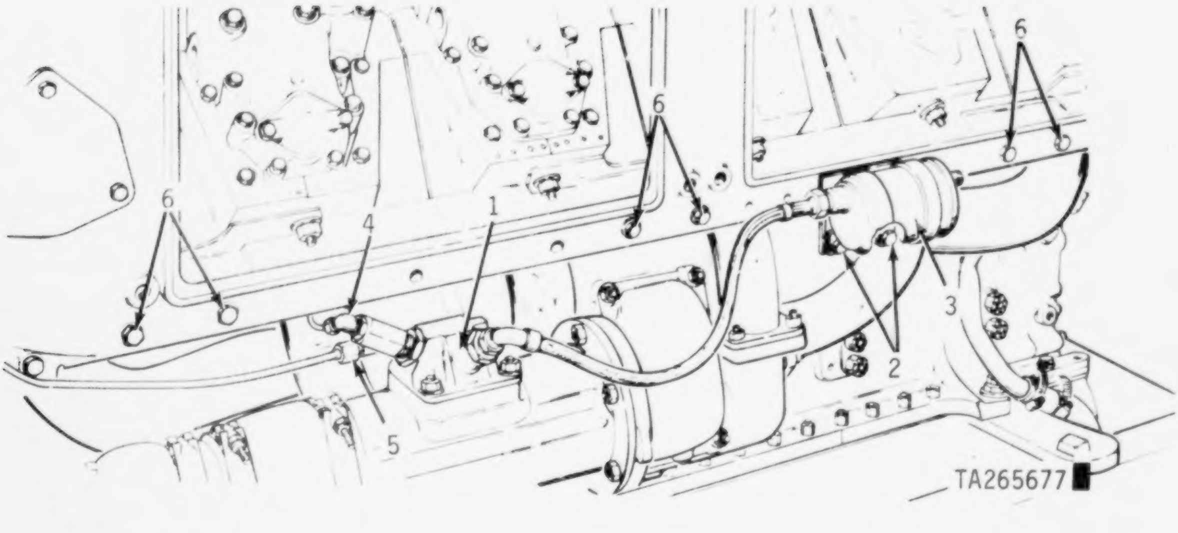
(4) Remove capscrew and self-locking nut (1, fig. 3-19) and self-locking nut, machine bolt, grommet and two spacers (2) and remove turbosupercharger support bracket (3). Remove three assembled washer bolts (4) and remove left transmission upper shroud assembly (5). Remove assembled washer bolt (6) and remove oil cooler support frame (7).

NOTE

Model AVDS-1790-2DR has four assembled washer bolts (6, fig. 3-19) securing the rear shroud to the oil cooler support frame.

3-10. Frame Support Brackets and Turbosupercharger Oil Inlet Hoses

a. Upper Cover Frame Support Brackets. Remove self-locking nut and machine bolt (fig. 3-20) and remove exhaust elbow retaining strap. Remove twelve self-locking nuts (fig. 3-20) attaching upper cover frame support brackets to cylinders



1 Manifold heater spark plug electrical lead
2 Capscrew and self-locking nut
3 Ignition unit
4 Nozzle inlet elbow
5 Manifold heater fuel return tube
6 Capscrew and self-locking nut

Figure 3-18. Disconnecting or connecting left bank oil cooler support frame.

and remove six brackets. Remove left side brackets and retaining strap in the same manner.

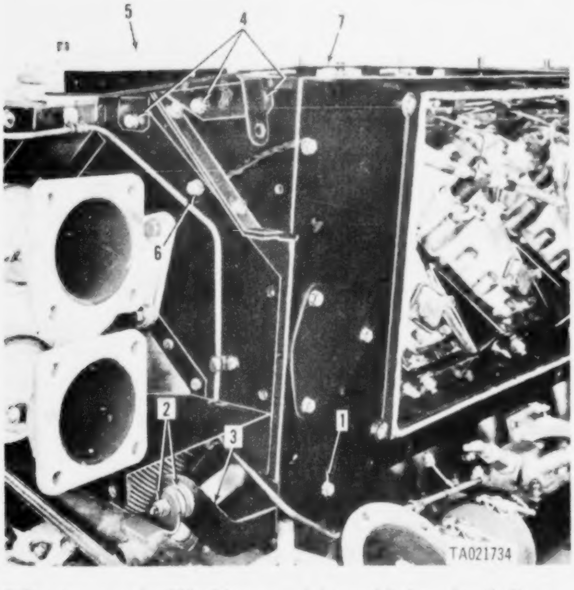
NOTE

Model AVDS-1790-2DR has a different support bracket mounted on the No. 2L cylinder. The No. 3L fuel injector tube clamp must be removed at this point before the support bracket can be removed.

b. Turbosupercharger Oil Inlet Hose. Disconnect turbosupercharger oil inlet hose (fig. 3-21) from bulkhead adapter elbow. Remove one assembled washer bolt and cushioned clamp. Remove one capscrew and cushioned clamp securing oil inlet hose to camshaft gear housing cover. Remove oil inlet hose. Remove two machine screws and remove right transmission shroud. Remove left transmission shroud and oil inlet hose in the same manner.

NOTE

Model AVDS-1790-2DR has two assembled washer bolts and cushioned clamps securing the turbosupercharger oil inlet hose to the tie rod, and is not equipped with right and left transmission shrouds.



1 Capscrew and self-locking nut
2 Spacer and self-locking nut
3 Turbosupercharger support bracket
4 Assembled washer bolt
5 Transmission upper shroud
6 Assembled washer bolt
7 Oil cooler support frame

Figure 3-19. Removing or installing left oil cooler support frame, air baffle and turbosupercharger support bracket.

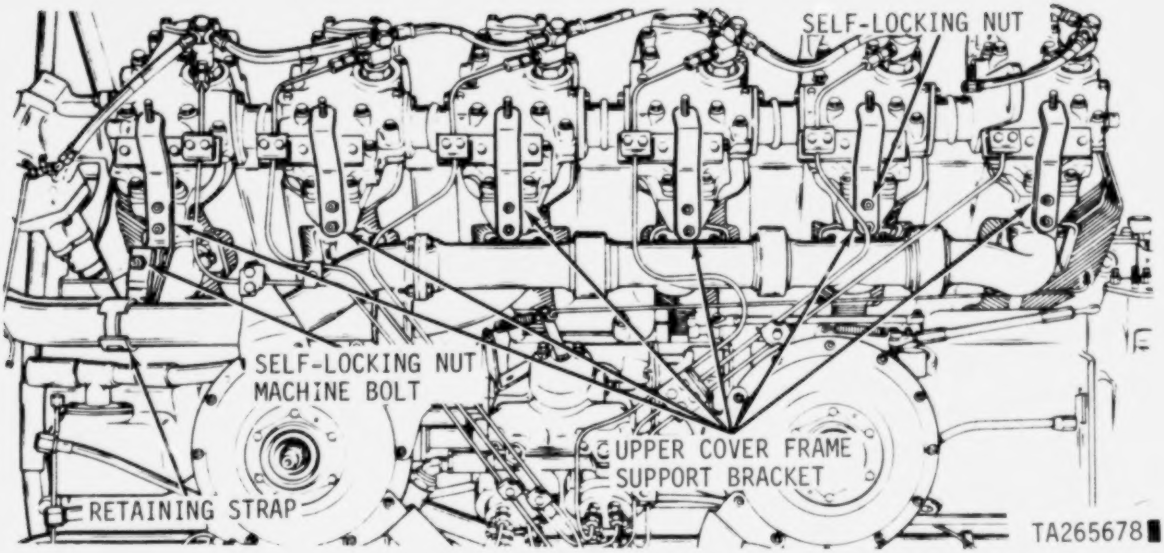

SELF-LOCKING NUT
SELF-LOCKING NUT
MACHINE BOLT
UPPER COVER FRAME
SUPPORT BRACKET
RETAINING STRAP
TA265678

Figure 3-20. Removing or installing right upper cover frame support brackets.

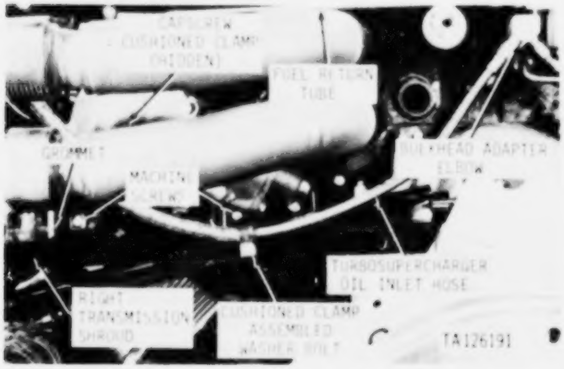
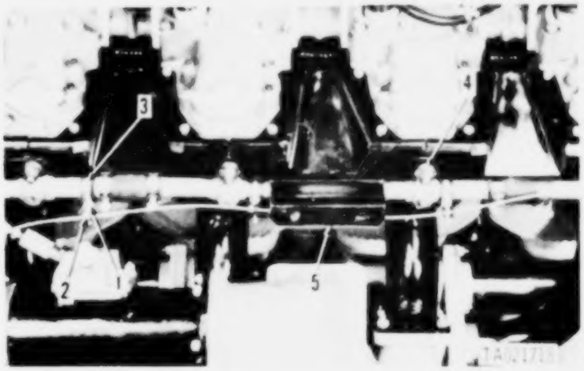

CAPSCREW
CUSHIONED CLAMP
(HIDDEN)
FUEL RETURN
TUBE
GROMMET
MACHINE
SCREWS
BULKHEAD ADAPTER
ELBOW
TURBOSUPERCHARGER
OIL INLET HOSE
RIGHT
TRANSMISSION
SHROUD
CUSHIONED CLAMP
ASSEMBLED
WASHER BOLT
TA126191

Figure 3-21. Removing or installing right turbosupercharger oil inlet hose and transmission shroud.



1 Capscrew and self-locking nut
2 Manifold heater fuel tube clamp
3 Hose clamp
4 Self-locking nut, spacer and grommet
5 Oil cooler frame support

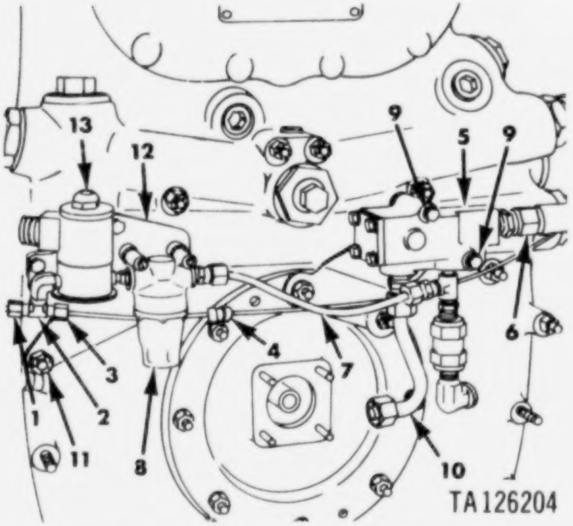
Figure 3-22. Disconnecting or connecting left manifold heater fuel inlet tube and removing left oil cooler frame supports.

3-11. Manifold Heater Tubes, Solenoids, and Filter

a. Remove four capscrews and self-locking nuts (1, fig. 3-22) attaching manifold heater fuel tube clamps (2) to hose clamps (3) and remove clamps. Remove six self-locking nuts, spacers, and grommets (4) and remove three oil cooler frame supports (5). Disconnect manifold heater fuel tubes and remove oil cooler frame supports on right side of engine in the same manner.

b. Disconnect and remove left manifold heater fuel tube (1, fig. 3-23) from solenoid outlet tee (2). Disconnect right manifold heater fuel tube (3) from solenoid outlet tee. Remove self-locking nut and loop clamp (4) and remove tube. Disconnect backflow valve fuel inlet hose (6) at primary fuel filter and at backflow valve and remove hose. Disconnect manifold heater fuel filter fuel inlet tube (7) at the fuel filter (8). Remove fuel backflow valve mounting capscrews, lockwashers and flat washers (9) and remove fuel backflow valve, and fuel pump fuel inlet tube (10). Remove two mounting bracket self-locking nuts (11) and remove manifold heater fuel filter, solenoid valve and mounting bracket (12) as an assembly.

b.1 Disconnect and remove left manifold heater fuel tube (1, fig. 3-23.1) from solenoid outlet tee (2). Disconnect right manifold heater fuel tube (3) from solenoid outlet tee (2). Remove self-locking nut and cushioned clamp (4) and remove tube. Disconnect backflow valve fuel inlet hose (5) at primary fuel filter and at backflow valve and remove hose. Disconnect and remove manifold heater fuel inlet tube (6).



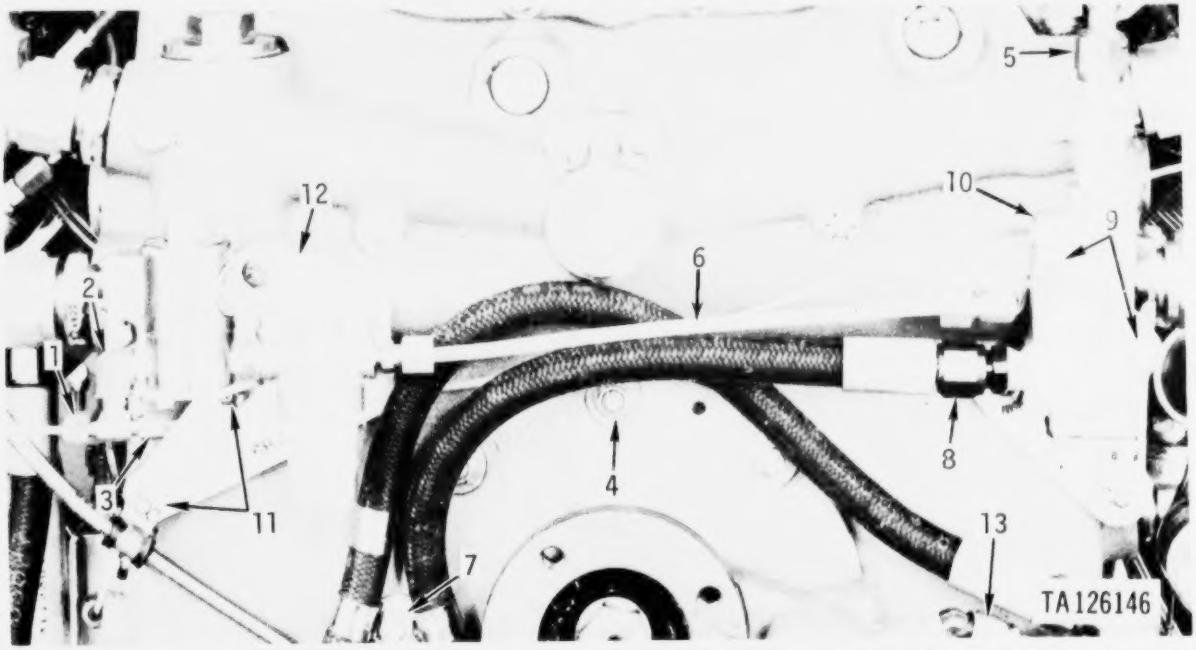
1	Left manifold heater fuel tube
2	Solenoid outlet tee
3	Right manifold heater fuel tube
4	Self-locking nut and loop clamp.
5	Fuel backflow valve
6	Backflow valve fuel inlet hose
7	Manifold heater fuel filter fuel inlet tube
8	Fuel filter
9	Capscrew, lockwasher and flat washer
10	Fuel pump fuel inlet tube
11	Self-locking nut
12	Mounting bracket
13	Solenoid valve

Figure 3-23. Removing or installing fuel backflow valve and manifold heater fuel filter, solenoid valve and fuel lines, model AVDS-1790-2C and AVDS-1790-2D engines.

Remove self-locking nut (7) and fuel tube cushioned clamp. Disconnect and remove fuel pump fuel inlet hose (8). Remove two capscrews, lockwashers and flat washers (9) and remove fuel backflow valve (10). Remove two self-locking nuts (11) and remove manifold heater filter, solenoid valve and mounting bracket (12) as an assembly. Disconnect oil inlet hose (13) at 45 degree elbow and at 90 degree elbow and pipe bushing in right side of crankcase and remove hose. Remove 90 degree elbow and bushing from crankcase.

c. Disconnect turbosupercharger oil hose (1, fig. 3-24) at bulkhead adapter elbow (2), and remove nut, washer, and bulkhead adapter elbow. Disconnect fuel return hose (3), fuel injector nozzle fuel return tubes (4) and manifold heater fuel return tube (5).

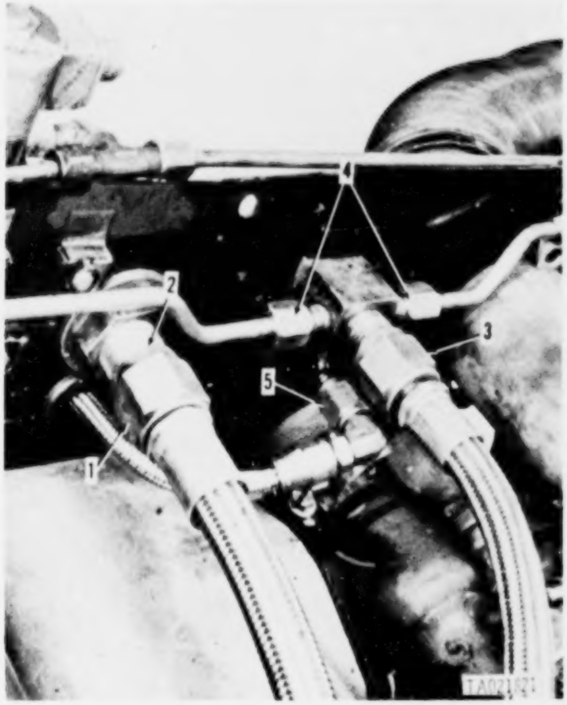
c.1. Deleted.



1	Left manifold heater fuel tube
2	Solenoid outlet tee
3	Right manifold heater fuel tube
4	Cushioned clamp and self-locking nut
5	Backflow valve fuel inlet hose
6	Manifold heater fuel inlet tube
7	Self-locking nut
8	Fuel pump fuel inlet hose
9	Capscrew, lockwasher and flat washer
10	Fuel backflow valve
11	Self-locking nut
12	Mounting bracket
13	Oil inlet hose

Figure 3-23.1. Removing or installing fuel backflow valve and manifold heater fuel filter, solenoid valve and fuel lines, model AVDS-1790-2DR engine.

d. Disconnect right manifold heater fuel return tube (1, fig. 3-25). Remove machine screw (2). Remove tube and two loop clamps. Remove left manifold heater fuel return tube in the same manner. Remove fuel return tube shroud grommet (3), and disconnect and remove manifold heater fuel return tube (4) remove three assembled washer bolts (5) and remove solenoid bracket, solenoid valve (6) check valve (7) and fittings as an assembly. Remove nut, washer, and tube cross (8) from shroud. Remove hose clamp (9) from breather tube. Remove three machine screws and lockwashers (10) and remove right (11) and left (12) rear center shrouds.

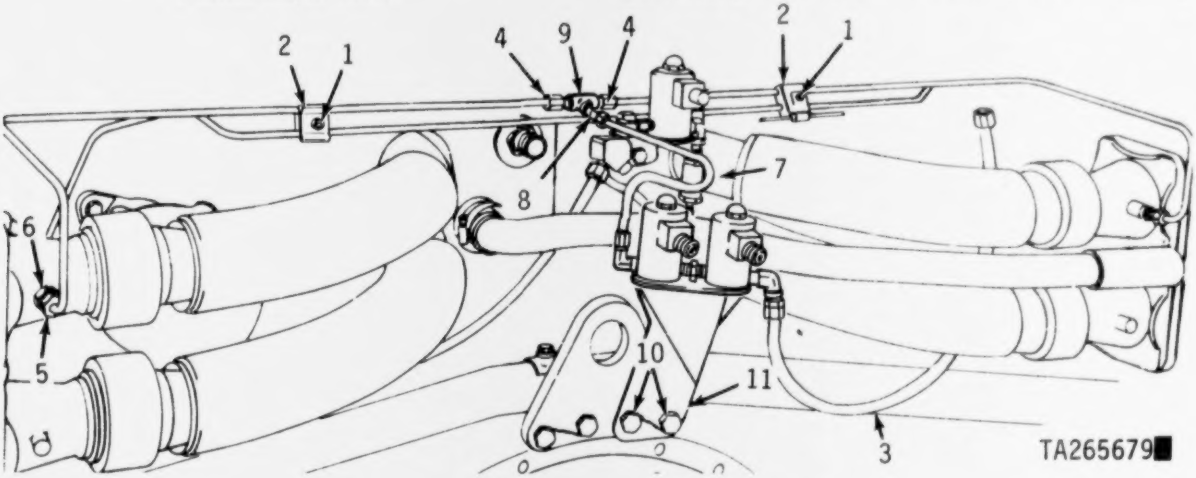


1 Turbosupercharger oil hose
2 Bulkhead adapter elbow
3 Fuel injector fuel return hose
4 Fuel injector nozzle fuel return tubes
5 Manifold heater fuel return tube

Figure 3-24. Disconnecting or connecting fuel return lines and solenoid valve bracket and removing bulkhead adapter elbow.

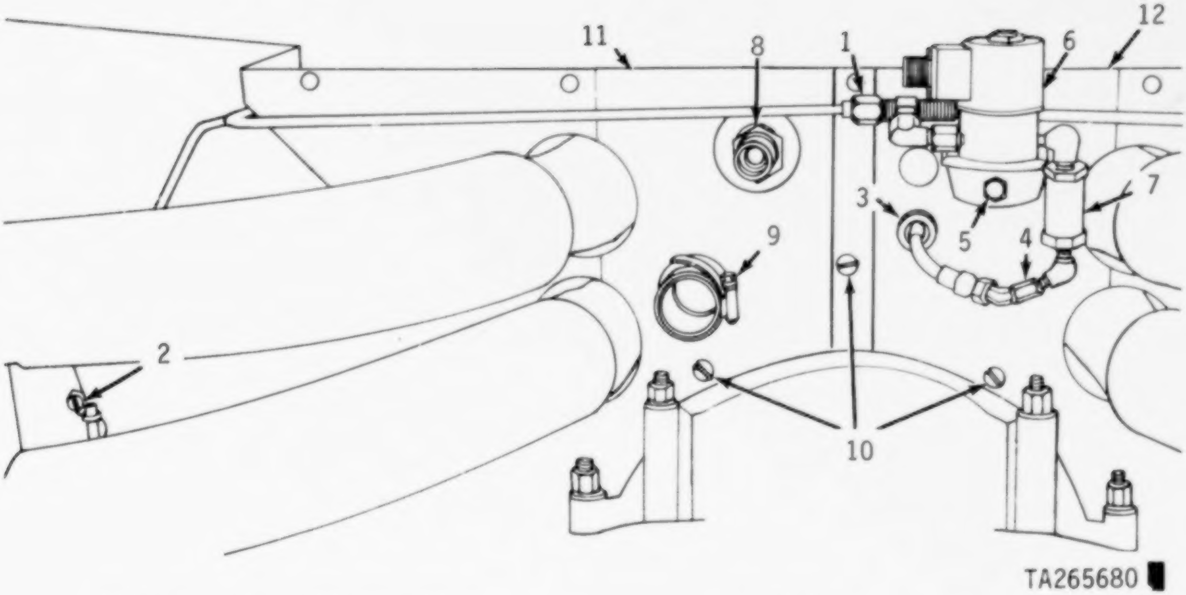
3-11.1. Smoke Generating Solenoids and Fuel Tubes

a. On Models AVDS-1790-2C and AVDS-1790-2D, disconnect the tube nut of solenoid fuel inlet tube (3, fig. 3-24.1). Remove nut securing fuel inlet tube loop clamp to cam gear housing cover (not shown) and remove loop clamp and tube. Disconnect tube nuts on both ends of solenoid outlet tube (7) and remove tube. Cut locking wire, remove two capscrews (10) and remove solenoids and bracket (11) as an assembly. Disconnect two tube nuts (4) and remove tee (9) and elbow (8). Remove two capscrews and self-locking nuts (1) and remove two retaining



1 Capscrew and self-locking nut
2 Retaining strap
 and clamp pad
3 Fuel tube
4 Fuel tube nut
5 Fuel tube nut
6 Adapter
7 Fuel tube
8 Elbow
9 Tee
10 Capscrew
11 Bracket

Figure 3-24.1. Removing or installing smoke generating fuel tubes, hoses, solenoid valves, and associated parts, model AVDS-1790-2C and AVDS-1790-2D engines.



1 Right manifold heater fuel return tube
2 Machine screw
3 Grommet
4 Manifold heater fuel return
5 Assembled washer bolt
6 Solenoid valve
7 Check valve
8 Tube cross
9 Hose clamp
10 Machine screw and lockwasher
11 Right rear center shroud
12 Left rear center shroud

Figure 3-25. Removing rear fuel return solenoid valve, tube cross and right and left rear center shroud.

straps and clamp pads (2). Loosen two tube nuts (5) and remove adapters (6) from exhaust manifolds. Remove fuel lines and discard.

b. On Model AVDS-1790-2DR, remove the smoke generating solenoids, fuel tubes and associated hardware in a similar manner, except the two fuel tubes from the tee to the exhaust manifold are secured to the rear shrouds with two assembled washer bolts and loop clamps.

3-11.2. Turbocharger Drive Housing (Power Takeoff)

Refer to paragraph 2-49.1 for removal of the power takeoff drive housing.

3-12. Cylinder Head Oil Drain Lines and Intake Manifold Assembly

a. Remove two capscrews and lockwashers (fig. 3-26) attaching right rear cylinder head oil drain tube to oil pan. Remove two capscrews and lockwashers (fig. 3-27) attaching right front cylinder head oil drain tube to oil pan. Disconnect the left front and rear cylinder head oil drain tubes in the same manner (figs. 3-28 and 3-29).

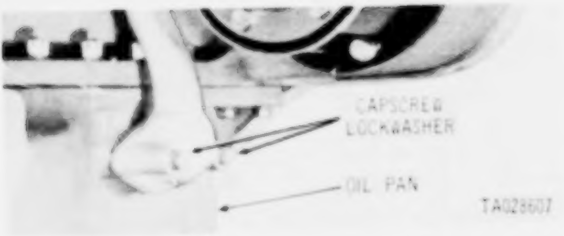

CAPSCREW
LOCKWASHER
OIL PAN
TA028607

Figure 3-26. Disconnecting or connecting right rear cylinder head oil drain tube.

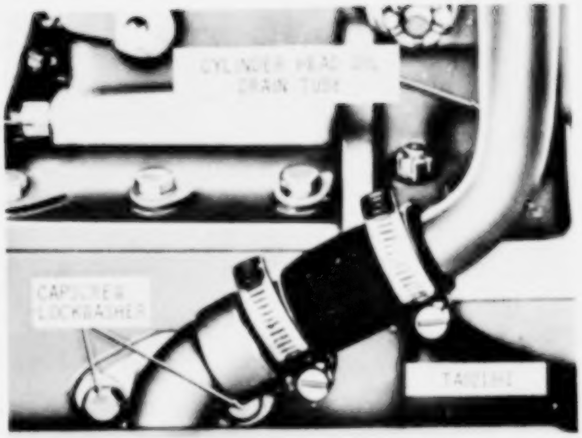

CYLINDER HEAD OIL
DRAIN TUBE
CAPSCREW
LOCKWASHER

Figure 3-27. Disconnecting or connecting right front cylinder head oil drain tube.

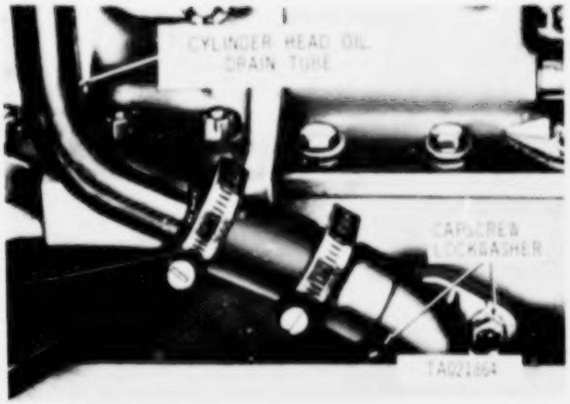

CYLINDER HEAD OIL DRAIN TUBE
CAPSCREW LOCKWASHER
TA021864

Figure 3-28. Disconnecting or connecting left front cylinder head oil drain tube.

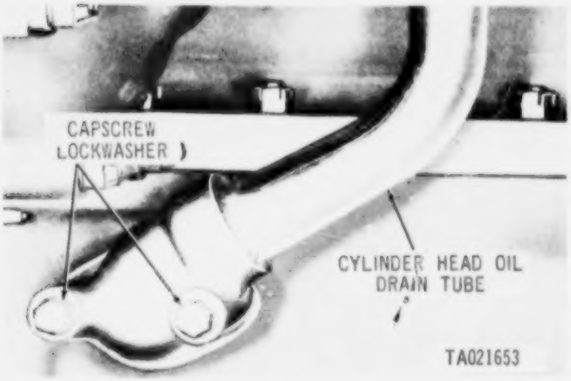

CAPSCREW LOCKWASHER
CYLINDER HEAD OIL DRAIN TUBE
TA021653

Figure 3-29. Disconnecting or connecting left rear cylinder head oil drain tube.

b. Loosen hose clamps (fig. 3-30) and remove cylinder head oil drain tube, three hoses and turbosupercharger oil drain tube as an assembly. Disassemble parts. Remove left cylinder head oil drain tubes in the same manner.

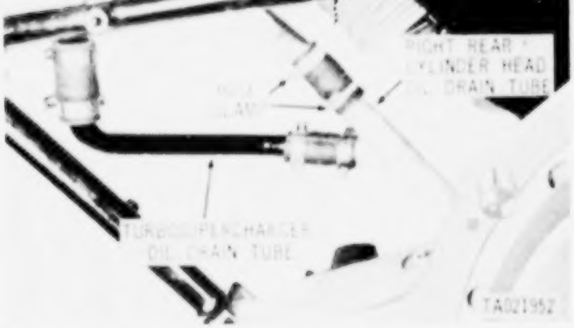
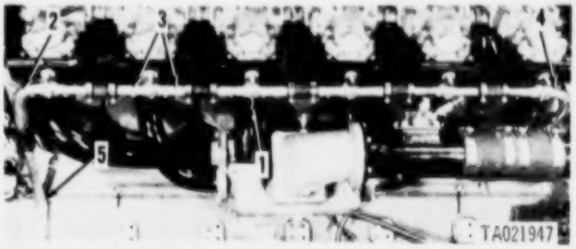

RIGHT REAR CYLINDER HEAD OIL DRAIN TUBE
HOSE CLAMP
TURBOSUPERCHARGER OIL DRAIN TUBE
TA021952

Figure 3-30. Removing or installing right rear cylinder head oil drain tube and turbosupercharger oil drain tube.

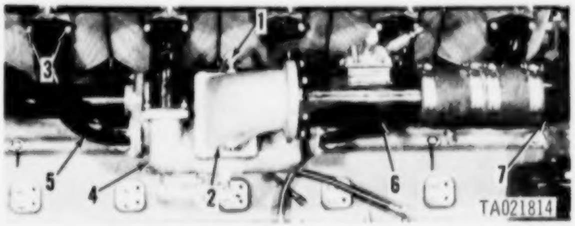
c. Cut locking wire and remove six cylinder head oil drain tube bolts and flat washers (1, fig. 3-31). Remove front and rear cylinder head oil drain tubes and intermediate tubes (2, 3, 4, and 5) as an assembly. Remove and discard flat washers. Remove left side cylinder head oil drain tubes, intermediate tubes and front drain tube in the same manner.


2
3
4
5
1
TA021947

1 Bolt and washer
2 Front cylinder head oil drain manifold tube
3 Intermediate cylinder head oil drain manifold tube
4 Rear cylinder head oil drain manifold tube
5 Right front cylinder head oil drain tube

Figure 3-31. Removing or installing right side cylinder head oil drain manifold tubes.

d. Disconnect and remove alternator vent hose (1, fig. 3-32) from intake manifold elbow (2). Remove eighteen plain nuts and lockwashers (3) attaching intake manifold tubes to cylinders and remove manifold (4), intake manifold heater elbow (2), intake manifold tubes (5), turbosupercharger intake manifold tube (6), and turbosupercharger air outlet elbow (7) as an assembly. Remove and discard manifold tube gaskets. Remove the left intake manifold assembly in the same manner.


1
3
5
4
2
6
7
TA021814

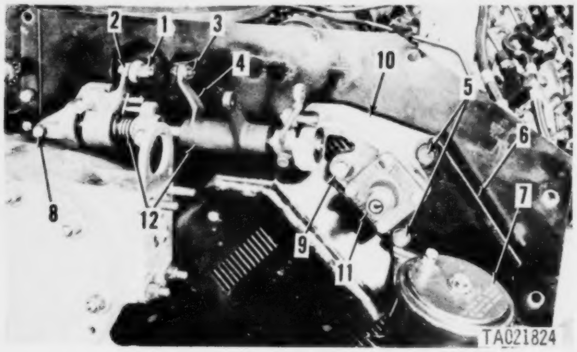
1 Alternator vent hose
2 Intake manifold elbow
3 Nut and washer
4 Intake manifold
5 Intake manifold tube
6 Turbosupercharger intake manifold tube
7 Turbosupercharger air outlet elbow.

Figure 3-32. Removing or installing right intake manifold assembly.

3-13. Primary Fuel Filter, Throttle Linkage Cross Shaft, and Brackets

a. Remove capscrew and self-locking nut (1, fig. 3-33) and separate control rod from injection pump fuel lever (2). Remove cotter pin and flat washer (3) and disconnect rod from manual fuel shutoff lever (4). Remove two capscrews and lockwashers (5) securing fuel filter bracket (6) and camshaft end plate to the cylinder, and remove primary fuel filter (7) and bracket (6) as an assembly.

b. Remove two assembled washer bolts (8) securing cross shaft support to damper and filter housing, and one capscrew and lockwasher (9) securing camshaft end plate (10) to cylinder and remove end plate with tachometer drive adapter (11) and throttle linkage cross shaft (12) as an assembly. Remove and discard end plate mounting gasket.

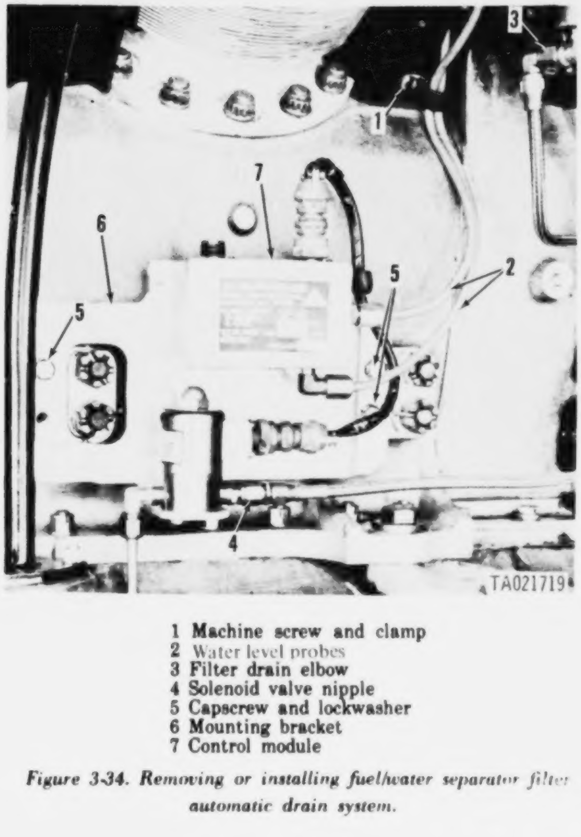


1 Capscrew and self-locking nut
2 Injection pump fuel lever
3 Cotter pin and flat washer
4 Manual fuel shutoff lever
5 Capscrew and lockwasher
6 Primary fuel filter bracket
7 Primary fuel filter
8 Assembled washer bolt
9 Capscrew and lockwasher
10 Camshaft end plate
11 Tachometer drive adapter
12 Throttle linkage cross shaft

Figure 3-33. Removing or installing throttle linkage cross shaft. and primary fuel filter and bracket.

3-14. Fuel/Water Separator and Automatic Drain System

a. Drain fuel/water separator, para 2-24 *a*. (1). Remove filter mounting capscrew, lockwasher and cushioned clamp (1, fig. 3-36). Loosen but do not remove two upper capscrews (2) and one lower capscrew (3). Pull fuel water separator away from bracket (4), and disconnect two water level probes (5) from the filter. Remove two machine screws and cushioned clamp (1, fig. 3-34) securing water level probes (2) to shroud plate. Disconnect filter drain hose from filter drain elbow (3) and from the solenoid valve nipple (4). Remove three capscrews and lockwashers (5) and remove mounting bracket (6), control module (7) and solenoid valve and fittings as an assembly. Remove self-locking nut (fig. 3-35) and remove assembled filter drain hose bracket and drain cock.



1 Machine screw and clamp
2 Water level probes
3 Filter drain elbow
4 Solenoid valve nipple
5 Capscrew and lockwasher
6 Mounting bracket
7 Control module

Figure 3-34. Removing or installing fuel/water separator filter automatic drain system.

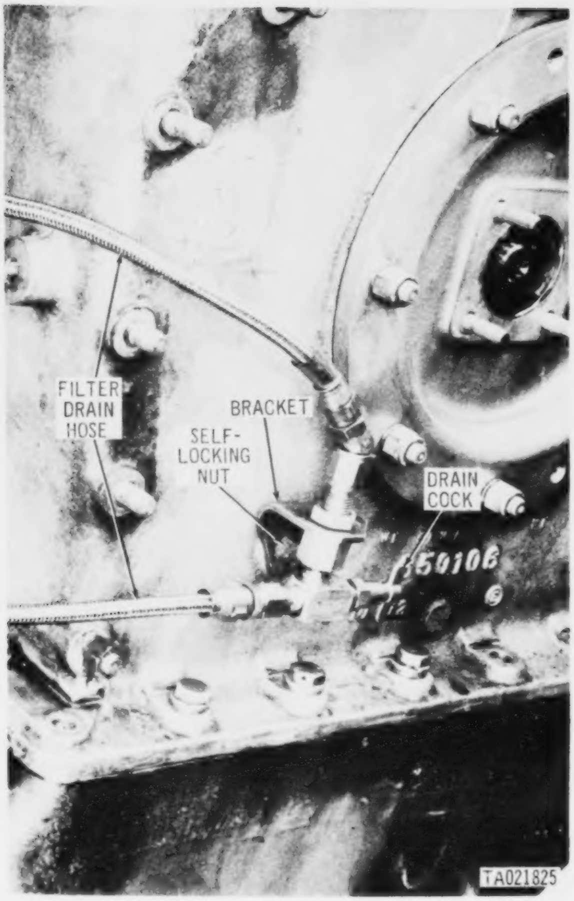
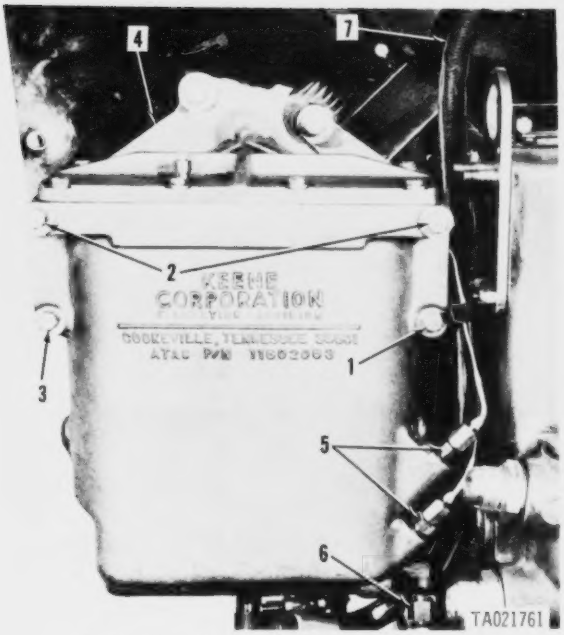

FILTER DRAIN HOSE
BRACKET
SELF-LOCKING NUT
DRAIN COCK
TA021825

Figure 3-35. Removing or installing fuel/water separator filter drain hose.

b. Disconnect and remove fuel inlet hose (6, fig. 3-36) from filter elbow. Disconnect fuel outlet hose (7) from filter elbow and from bulkhead elbow and remove hose. Remove lower capscrew, lockwasher and plain washer (3) and two capscrews, lockwashers and plain washers (2) and remove filter from mounting bracket (4).

c. Remove three screws and flat washers (fig. 3-37) securing filter mounting bracket to cylinder No. 1L and remove bracket. Remove and discard gasket.


4
7
2
3
1
5
6
TA021761

1 Capscrew, lockwasher, and cushioned clamp
2 Capscrew, lockwasher, and flat washer
3 Capscrew, plain washer and lockwasher
4 Mounting bracket
5 Water level probe
6 Fuel inlet hose
7 Fuel outlet hose

Figure 3-36. Removing or installing fuel/water separator filter.

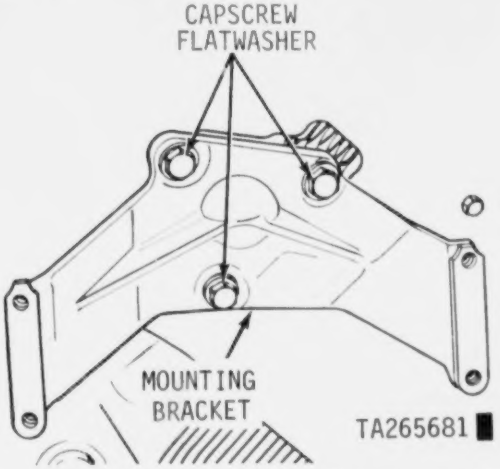

CAPSCREW
FLATWASHER
MOUNTING BRACKET
TA265681

Figure 3-37. Removing or installing fuel/water separator filter mounting bracket.

3-15. Front and Rear Shrouds

a. Front Shroud.

(1) Remove two machine screws (fig. 3-38) and remove cylinder barrel shroud. Remove cylinder barrel shroud for cylinder No. 1L in the same manner.

(2) Remove front shroud assembled washer bolt (1, fig. 3-39), machine screw and lockwasher (2) and machine screw (3). Remove two machine screws (4) attaching cylinder No. 1R baffle to front shroud and remove right front shroud (5) and cylinder No. 1R baffle (fig. 3-40).

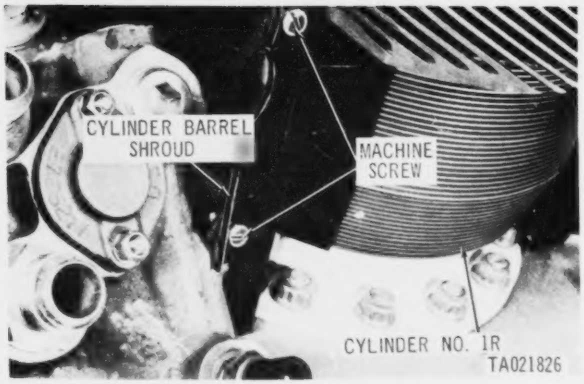
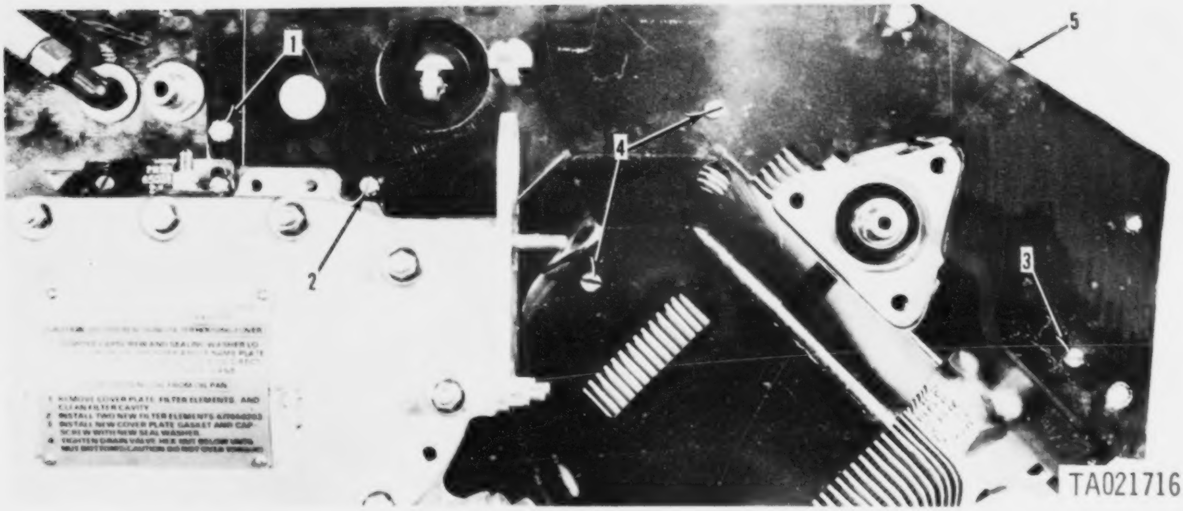


Figure 3-38. Removing or installing No. 1R cylinder barrel shroud.



1 Assembled washer bolt
2 Machine screw and lockwasher
3 Machine screw
4 Machine screw
5 Right front shroud

Figure 3-39. Removing or installing right front shroud and disconnecting cylinder No. 1R baffle.

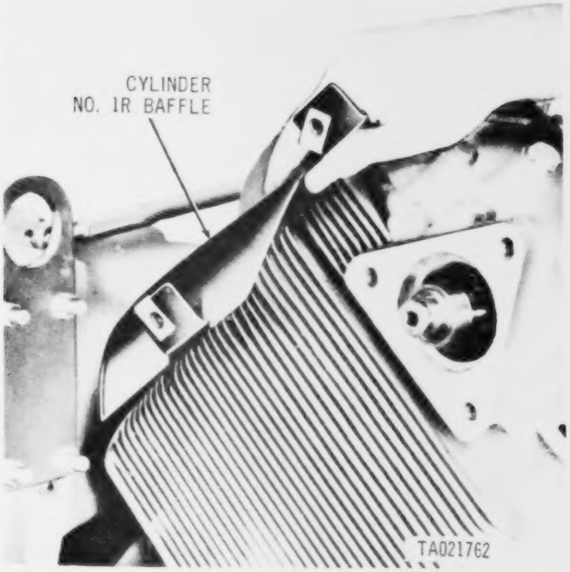
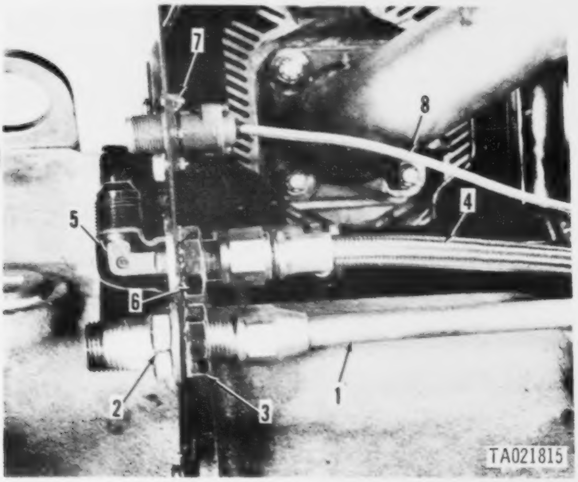


Figure 3-40. Removing or installing No. 1R cylinder baffle.



1 Fire extinguisher tube
2 Fire extinguisher bulkhead adapter
3 Nut and lockwasher
4 Fuel injection pump fuel inlet hose
5 Bulkhead elbow
6 Nut and lockwasher
7 Machine screw, lockwasher and nut
8 Fuel injection pump fuel cut-off lead

Figure 3-41. Disconnecting or connecting fire extinguisher tube, fuel inlet hose and fuel cut-off lead from front shroud, model AVDS-1790-2C and AVDS-1790-2D engines.

(3)Disconnect fire extinguisher tube (1, fig. 3-41) from bulkhead adapter (2). Remove bulkhead adapter nut and lockwasher (3) and remove adapter (2) and flat washer from shroud. Disconnect fuel injection pump fuel inlet hose (4) from bulkhead elbow (5). Remove nut and lockwasher (6), and remove elbow and flat washer from shroud. Remove four machine screws, lockwashers and nuts (7) and remove injection pump fuel cut-off lead (8) from left front shroud.

(3.1) Disconnect fire extinguisher tube (1, fig. 3-41.1) from fire extinguisher bulkhead adapter (2). Remove bulkhead adapter nut and lockwasher (3) and remove adapter (2) and flat washer from shroud. Disconnect fuel injection pump fuel inlet hose (4) from bulkhead elbow (5). Remove nut and lockwasher (6) and remove elbow and flat washer from shroud. Remove four machine screws, lockwashers and nuts (7) and remove fuel injection pump fuel cut-off lead (8) from shroud. Disconnect fuel return hose (9) from bulkhead adapter (10). Remove bulkhead adapter nut and lockwasher (11) and remove adapter (10) from shroud.

(4) Remove assembled washer bolt (1, fig. 3-42) and two machine screws and lockwashers (2) and remove top filler plate (3). Remove three machine screws and lockwashers (4) and three assembled washer bolts (5) and remove side filler plate (6). Remove machine screw (7) and two machine screw (8) attaching cylinder No. 1L baffle to left front shroud (9), and remove left front shroud and No. 1L cylinder baffle in the same manner as cylinder baffle No. 1R was removed.

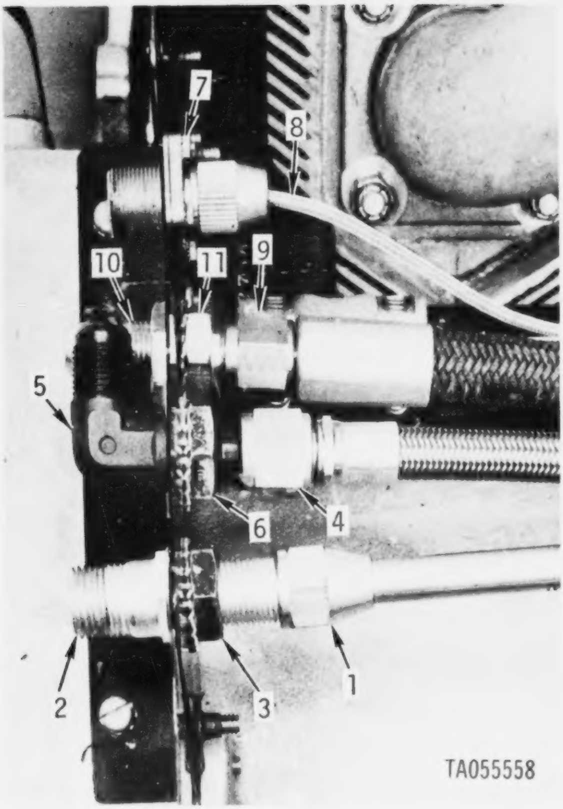
b. Rear Shroud.

(1) Models AVDS-1790-2D and AVDS-1790-2DR only. Remove two hose clamps and remove generator outlet preformed hose. Remove two machine screws, flat washers and lockwashers and remove generator exhaust tube.

(2) Remove five machine screws (fig. 3-43) and remove right rear shroud. Remove left rear shroud in the same manner.

3-16. Cylinder Head Plates, Oil Filler Tube and Oil Level Indicator Tube

Remove three capscrews and seal washers (1, fig. 3-44) and remove lower oil filler tube assembly (2) and hose and clamps as an assembly. Remove and discard gasket and seal washers. Remove two capscrews and lockwashers (3) and remove flywheel end cylinder head shroud plate (4). Remove



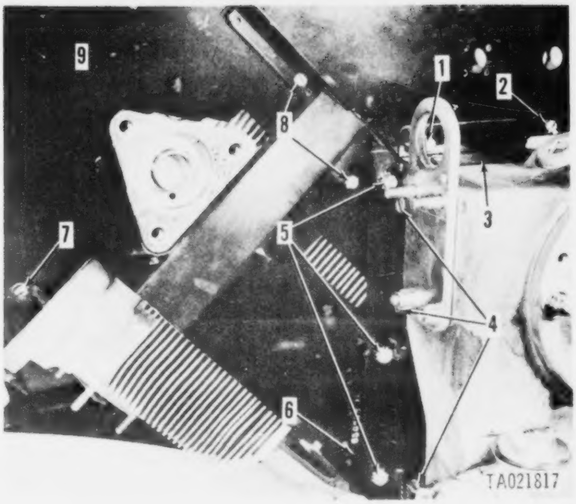
1 Fire extinguisher tube
2 Fire extinguisher bulkhead adapter
3 Nut and lockwasher
4 Fuel injection pump fuel inlet hose
5 Bulkhead elbow
6 Nut and lockwasher
7 Machine screw, lockwasher and nut
8 Fuel injection pump fuel cut-off lead
9 Fuel return hose
10 Bulkhead adapter
11 Nut and lockwasher

Figure 3-41.1. Disconnecting or connecting fire extinguisher tube, fuel inlet and return hoses and fuel cut-off lead from front shroud, model AVDS-1790-2DR engine.

two capscrews and lockwashers (5) and remove damper end cylinder head shroud plate (6). Remove twenty capscrews and lockwashers (7) and remove ten intercylinder head shroud plates (8). Remove three self-locking nuts (9) and remove oil level indicator tube (10). Remove and discard gasket. Remove right bank cylinder head shroud plates in the same manner.

NOTE

Removal instructions for the cylinder head plates, oil filler tube and oil lever indicator tube on Model AVDS-1790-2DR are similar to above except that the oil level indicator tube is located between cylinder numbers 2L and 3L.



1 Assembled washer bolt
2 Machine screw and lockwasher
3 Top filler plate
4 Machine screw and lockwasher
5 Assembled washer bolt
6 Side filler plate
7 Machine screw
8 Machine screw
9 Left front shroud

Figure 3-42. Removing or installing top and side filler plates, No. 1L cylinder baffle, and left front shroud.

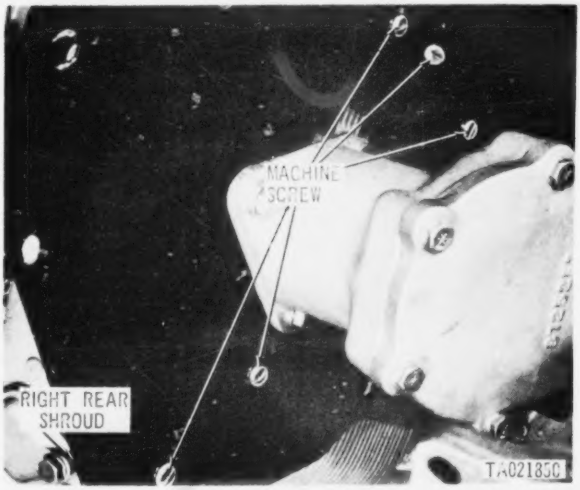
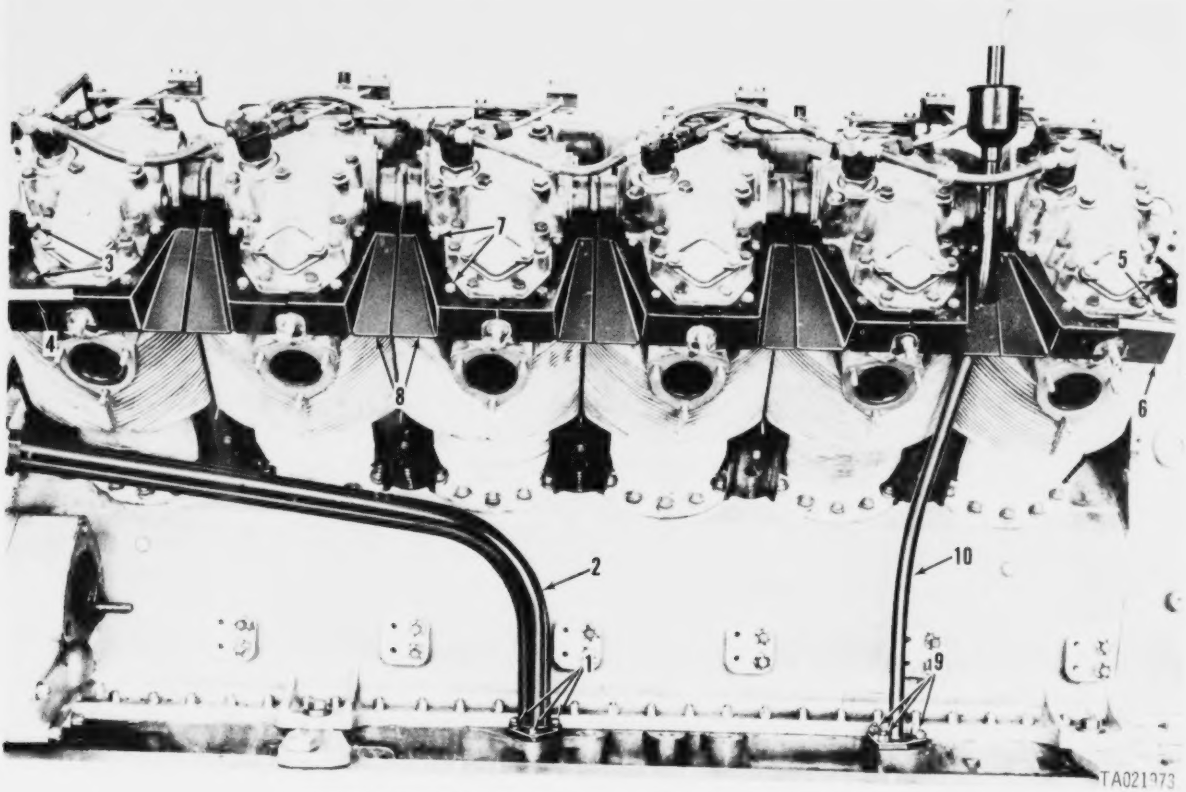


Figure 3-43. Removing or installing right rear shroud.

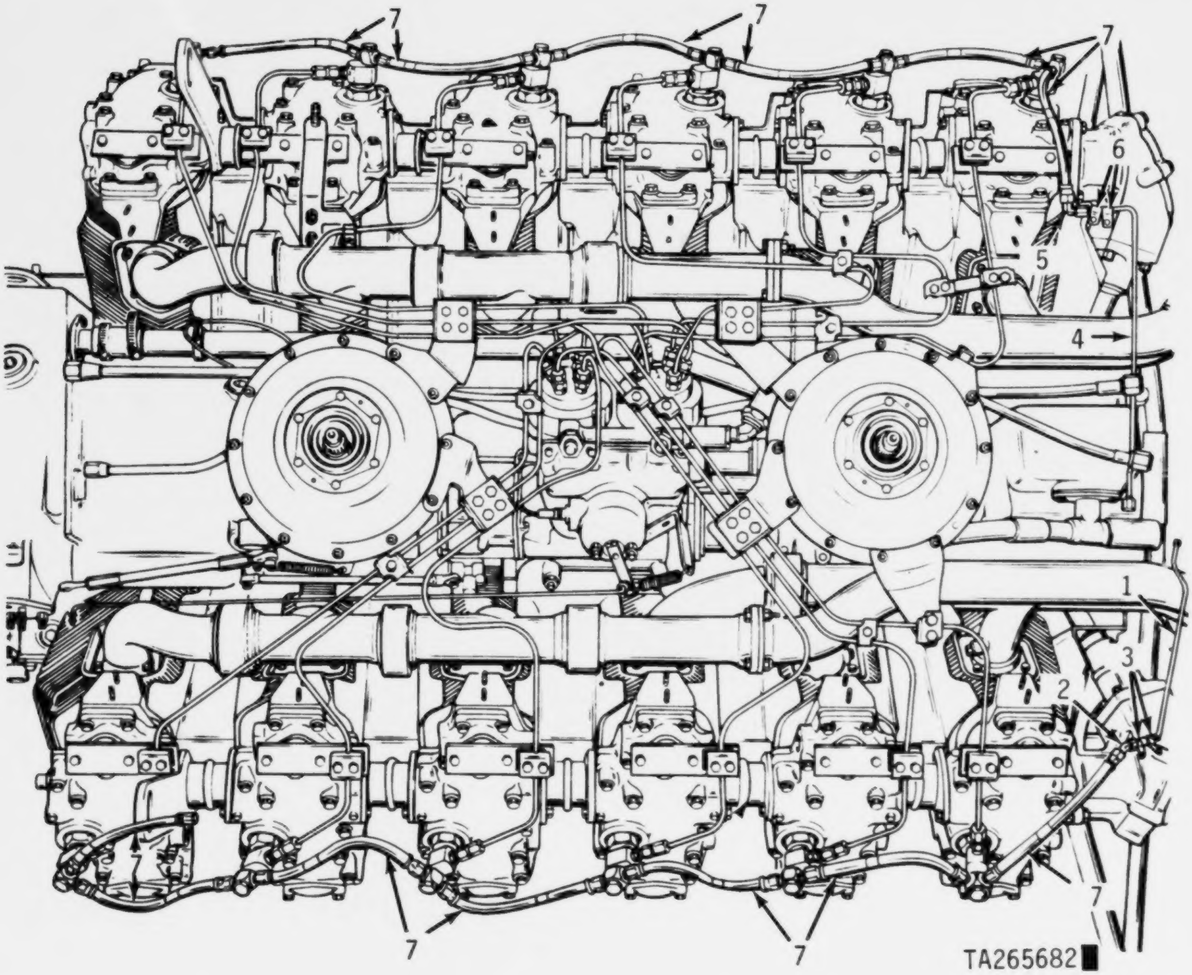
3-17. Fuel Injector Tubes, Supports and Clamps

a. Disconnect and remove right fuel return tube assembly (1, fig. 3-45). Remove elbow (2) and two loop clamps (3) from tube assembly. Disconnect and remove left fuel return tube assembly (4). Remove elbow (5) and two loop clamps (6) from left tube assembly. Disconnect and remove thirteen fuel injector nozzle fuel return hoses (7).



1 Capscrew and seal washer
2 Lower oil filler tube assembly
3 Capscrew and lockwasher
4 Flywheel end cylinder head shroud plate
5 Capscrew and lockwasher
6 Damper end cylinder head shroud plate
7 Capscrew and lockwasher
8 Intercylinder head shroud plate
9 Self-locking nut
10 Oil level indicator tube

Figure 3-44. Removing or installing cylinder head plates and oil filler and indicator tubes.


7
7
7
6
5
4
1
3
2
7
7
7
TA265682

1 Fuel return tube
2 Elbow
3 Loop clamp
4 Fuel return tube
5 Elbow
6 Loop clamp
7 Fuel return hose

Figure 3-45. Removing or installing fuel injector nozzle fuel return tubes.

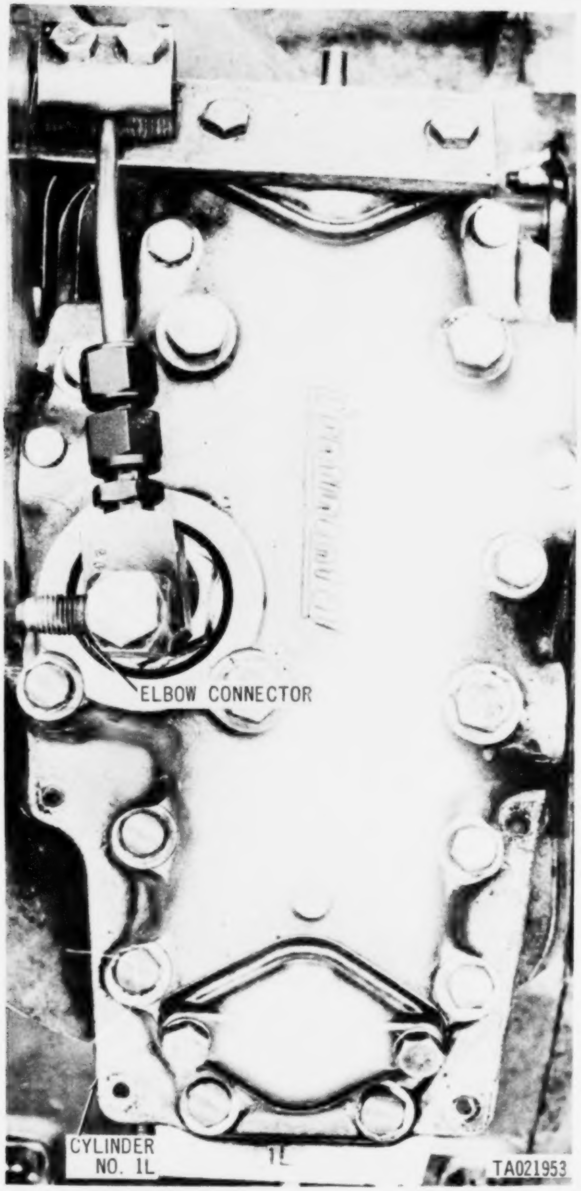


Figure 3-46. Removing or installing fuel injector nozzle, fuel tube connector and special bolt, cylinder No. 1L.

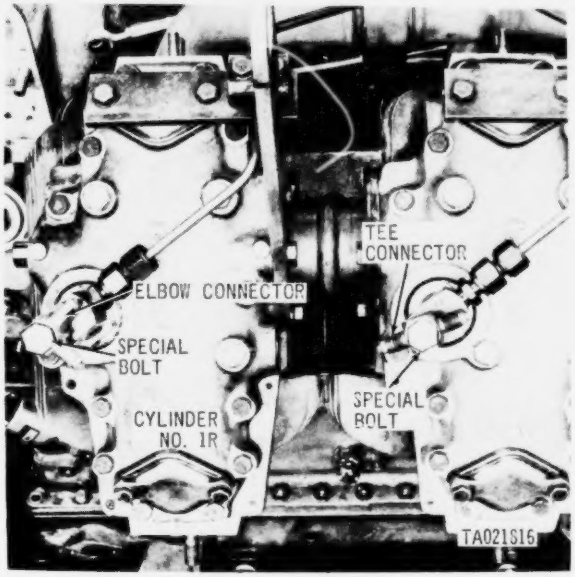


Figure 3-47. Removing or installing fuel injector nozzle, fuel tube elbow and tee connector, and special bolts.

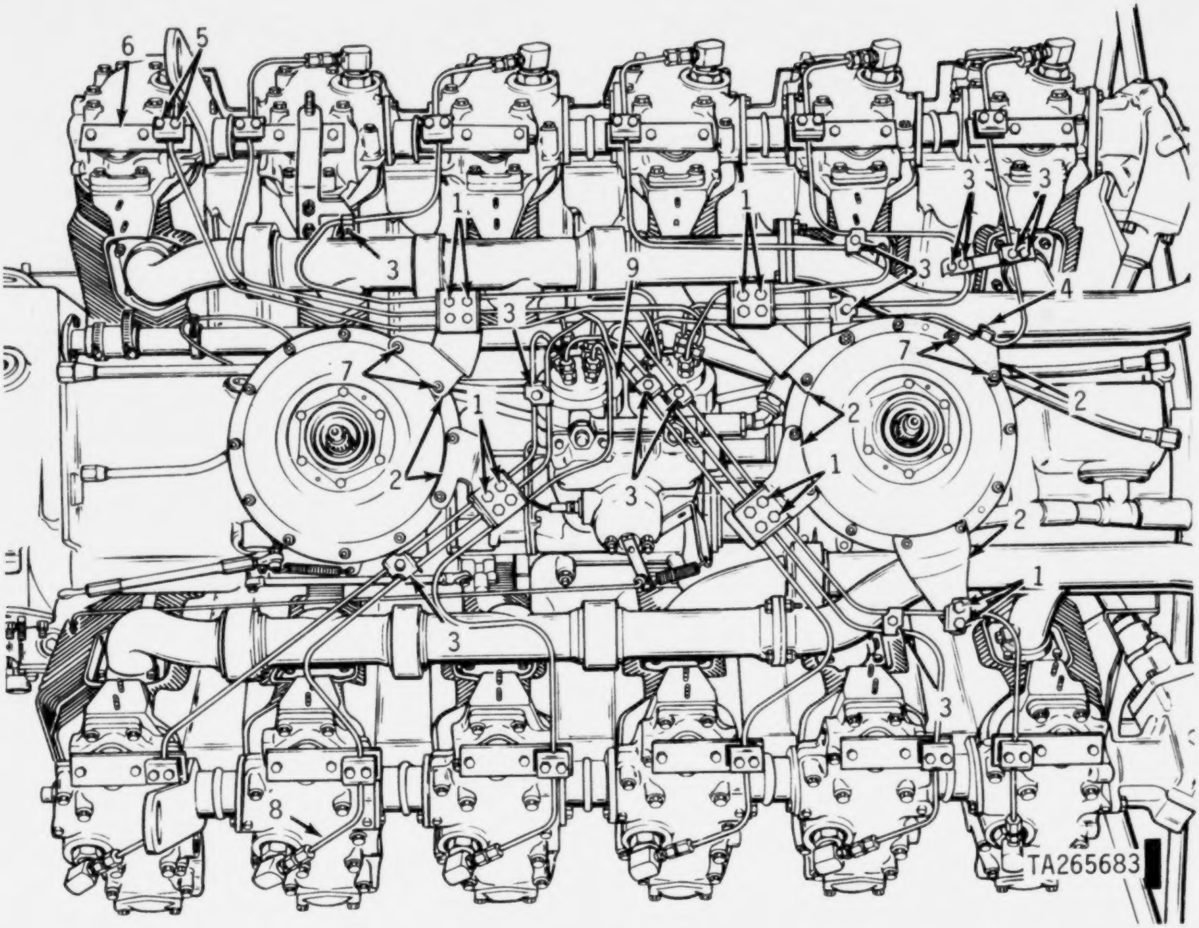
b. Remove special bolt attaching fuel tube connector (fig. 3-46) to nozzle and holder in cylinder No. 1L and remove connector. Remove and discard gaskets.

c. Remove special bolt attaching fuel tube elbow connector (fig. 3-47) to nozzle and holder in cylinder no. 1R, 6R, and 6L and remove elbow connectors. Remove eight special bolts attaching fuel tube tee connectors to nozzle and holder and remove eight tee connectors. Remove and discard gaskets.

d. Remove eighteen self-locking nuts and machine bolts (1, fig. 3-48) and associated plates and clamps from fuel injector tube clamp brackets (2). Remove twelve self-locking nuts and machine bolts (3) and associated plates and clamps from fuel injector tubes. Remove two self-locking bolts (4) and remove plate and clamps from fuel injector tube clamp bracket. Remove twenty four self-locking nuts and machine bolts (5) and remove twelve plates and twenty four tube clamps from right and left fuel injector tube clamp supports (6). Remove twelve self-locking nuts (7) and remove six tube clamp supports (2) from front and rear fan towers.

d.1 Deleted

e. Loosen support nuts and disconnect 12 fuel injector tubes (8) from injector nozzle and holder assemblies. Disconnect six fuel injector tubes from fuel injection pump front hydraulic head (10) and individually remove tubes. Disconnect six fuel injector tubes from fuel injection pump rear hydraulic head and individually remove tubes. After tubes have been removed, plug all fuel injection pump hydraulic head fuel ports to prevent entrance of dirt.



1 Self-locking nut and machine bolt	4 Self-locking nut	7 Self-locking nut
2 Tube clamp support	5 Self-locking nut and machine bolt	8 Fuel injector tube
3 Self-locking nut and maching bolt	6 Tube clamp support	9 Front hydraulic head

Figure 3-48. Removing or installing fuel injector tube clamps, brackets, supports and injector tubes, model AVDS-1790-2C and AVDS-1790-2D engines.

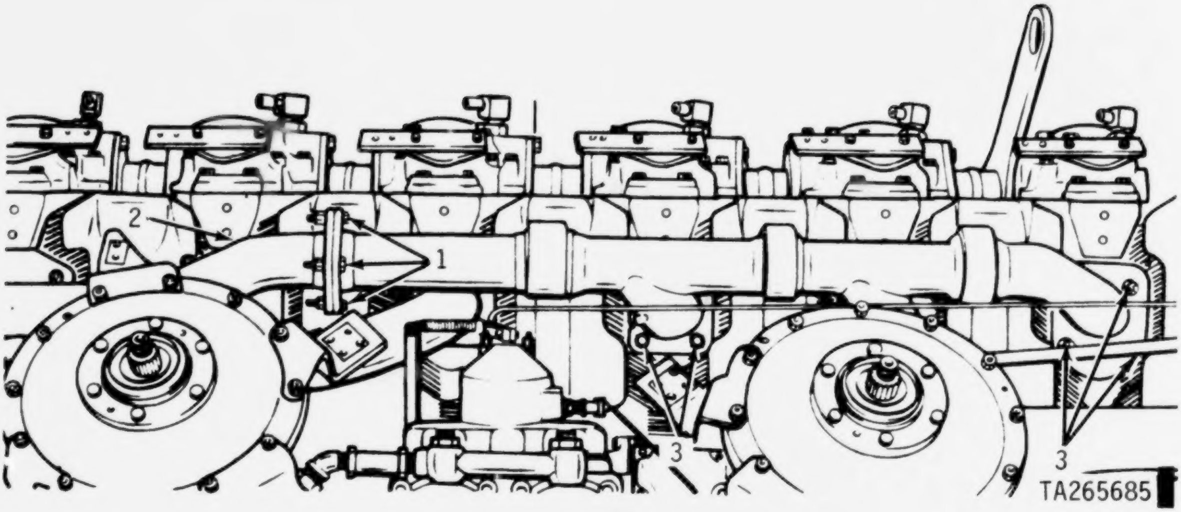
3-18. Exhaust Manifolds and Elbows

a. Remove four self-locking nuts, flat washers and machine bolts (1, fig. 3-49) securing exhaust elbow (2) to cylinder No. 1R, 2R and 3R exhaust manifold and remove exhaust elbow. Remove twelve self-locking nuts and flat washers (3) securing exhaust manifold tubes 1R, 2R, and 3R to the cylinders, and remove exhaust manifold. Remove and discard gaskets.

b. Remove four self-locking nuts, flat washers and bolts (1, fig. 3-50) securing exhaust elbow (2) to cylinder Nos. 1L, 2L and 3L exhaust manifold, and remove exhaust elbow. Remove twelve self-locking nuts and flat washers securing exhaust manifold tubes (3) 1L, 2L and 3L to the cylinders and remove exhaust manifold. Remove and discard gaskets.

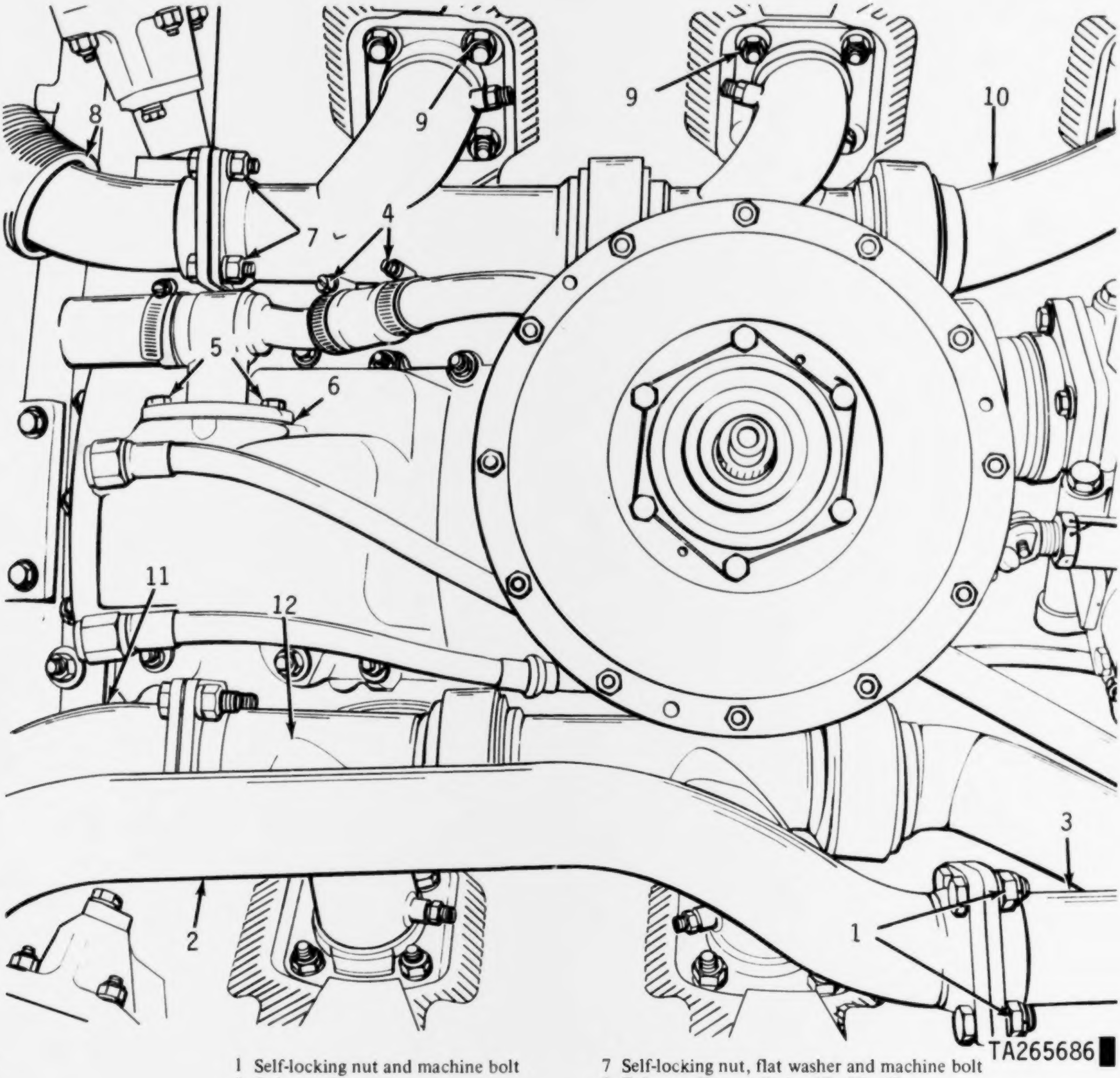
c. Loosen two breather tube clamps (4) and remove two bolts and lockwashers (5) and remove tube tee hoses, and the restrictor (6). Remove and discard gaskets.

Figure 3-48.1. Deleted.



1 Machine bolt and self-locking nut
2 Exhaust, elbow, cylinder 1R, 2R, 3R
3 Self-locking nut and flat washer

Figure 3-49. Removing or installing exhaust elbow and manifold cylinder Nos. 1R, 2R and 3R.



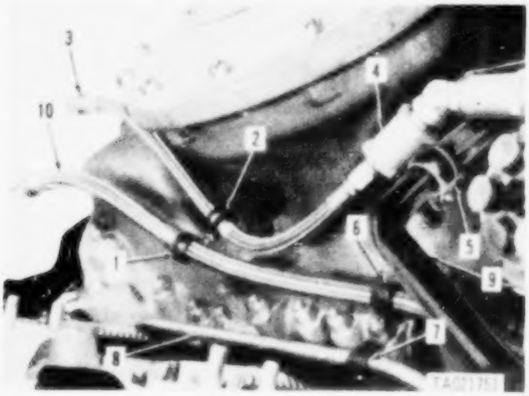
1 Self-locking nut and machine bolt
2 Exhaust elbow
3 Exhaust manifold tube 1L, 2L, 3L
4 Breather tube clamp
5 Bolt and washer
6 Restrictor
7 Self-locking nut, flat washer and machine bolt
8 Exhaust elbow cylinder 4R, 5R, 6R
9 Self-locking nut and flat washer
10 Exhaust manifold tube 4R, 5R, 6R
11 Exhaust elbow cylinder 4L, 5L, 6L
12 Exhaust manifold cylinder 4L, 5L, 6L

Figure 3-50. Removing or installing exhaust elbow and manifold cylinder Nos. 1L, 2L, and 3L, and exhaust elbow and manifold 4R, 5R, 6R, and 4L, 5L, and 6L.

d. Remove four self-locking nuts, flat washers and bolts (7) securing exhaust elbow (8) to cylinder Nos. 4R, 5R and 6R exhaust manifold and remove exhaust elbow. Remove twelve self-locking nuts and flat washers (9) securing exhaust manifold tubes (10) 4R, 5R and 6R to the cylinders and remove exhaust manifold. Remove exhaust elbow (11) and exhaust manifold (12) from cylinder Nos. 4L, 5L and 6L in the same manner as 4R, 5R and 6R. Remove and discard gaskets.

3-19. Fuel Inlet and Return Hoses, Fuel Injection Pump Oil Inlet Hose, Crankcase Breather Tube, Electrical Lead and Turbosupercharger Oil Inlet Hose.

a. Remove machine screw and self-locking nut attaching turbosupercharger oil hose cushioned clamp (1, fig. 3-51) to fuel return hose cushioned clamp (2) and remove clamps from hoses. Disconnect and remove fuel return hose (3) and remove fuel return check valve (4) from elbow in the injection pump. Remove self-locking nut and flat washer securing breather tube cushioned clamp (5) to rear fan drive housing and remove cushioned clamp from breather tube. Remove self-locking nut securing turbosupercharger oil hose cushioned clamp (6) and fire extinguisher tube cushioned clamp (7) to fan drive housing and remove clamps from hose and tube.



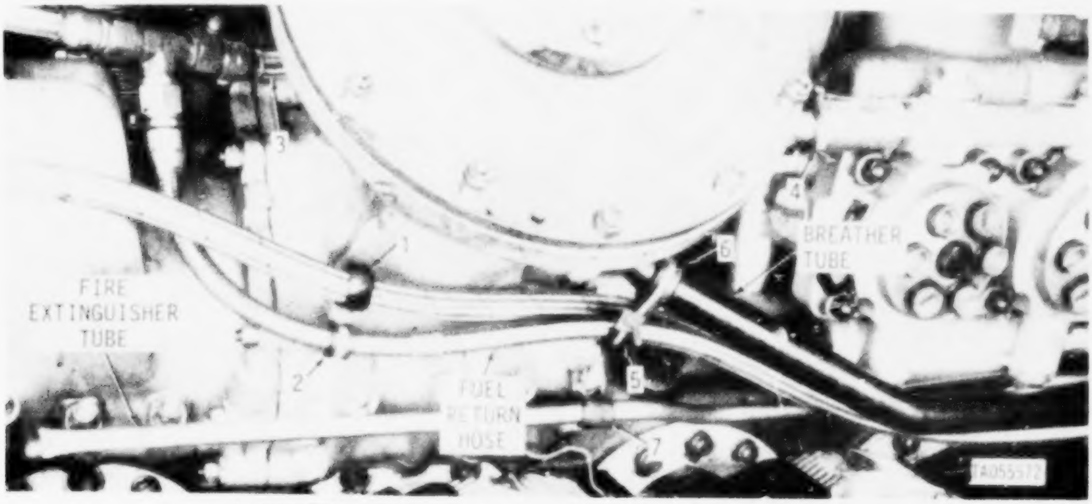
1 Cushioned clamp
2 Cushioned clamp
3 Fuel return hose
4 Fuel return check valve
5 Cushioned clamp
6 Cushioned clamp
7 Cushioned clamp
8 Fire extinguisher tube
9 Breather tube
10 Turbosupercharger oil inlet hose

Figure 3-51. Removing or installing fuel return hose, model AVDS-1790-2C and AVDS-1790-2D engines.

a.1. Remove machine screw and self-locking nut attaching turbosupercharger oil hose cushioned clamp (1, fig. 3-51.1) to fuel return hose cushioned clamp (2) and remove clamps from hoses. Disconnect fuel return hose (3) from elbow in fuel return check valve (4). Remove self-locking nut and machine screw and remove fuel return hose cushioned clamp (5) and breather tube dushioned clamp (6). Remove self-locking nut and remove cushioned clamp (7) from fire extinguisher tube. Remove self-locking nut and flat washer securing breather tube cushioned clamp (5, fig. 3-51) and remove clamp from breather tube.

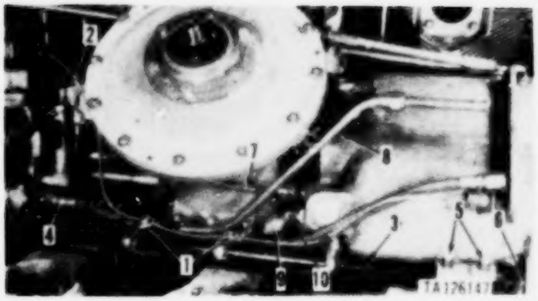
b. Remove three screws and self-locking nuts attaching crankcase breather tubes, fuel inlet hose and fuel injection pump electrical lead cushioned clamps (1, fig. 3-52). Remove three small cushioned clamps from electrical lead (2), three large cushioned clamps from crankcase breather tube (3) and the remaining two cushioned clamps from the fuel inlet hose (4). Disconnect and remove electrical lead and fuel inlet hose at the fuel injection pump. Loosen two hose clamps (5) and remove crankcase breather tube clamps and hose. Remove two self-locking nuts and remove crankcase breather tube assembly (6). Remove and discard gasket.

b.1. Remove machine screw and self-locking nut and remove two cushioned clamps (1, fig. 3-52.1) securing the fuel return hose to the breather tube. Remove two self-locking nuts and machine screws and remove six cushioned clamps (2) securing the electrical lead (3) and fuel injection pump fuel inlet hose (4) to the breather tube. Remove self-locking nut and machine bolt and remove two cushioned



1 Cushioned clamp
2 Cushioned clamp
3 Fuel return hose
4 Fuel return check valve
5 Cushioned clamp
6 Cushioned clamp
7 Cushioned clamp

Figure 3-51.1. Disconnecting or connecting fuel return hose, model AVDS-1790-2DR engine.



1 Cushioned clamp
2 Electrical lead
3 Crankcase breather tube
4 Fuel inlet hose
5 Hose clamp
6 Breather tube adapter
7 Fuel injection pump oil inlet hose
8 Fire extinguisher tube
9 Turbosupercharger oil inlet hose
10 Elbow

Figure 3-52. Removing or installing electrical lead, crankcase breather tube, injection pump oil inlet hose, turbosupercharger oil inlet hose and fire extinguisher, model AVDS-1790-2C and AVDS-1790-2D engines.

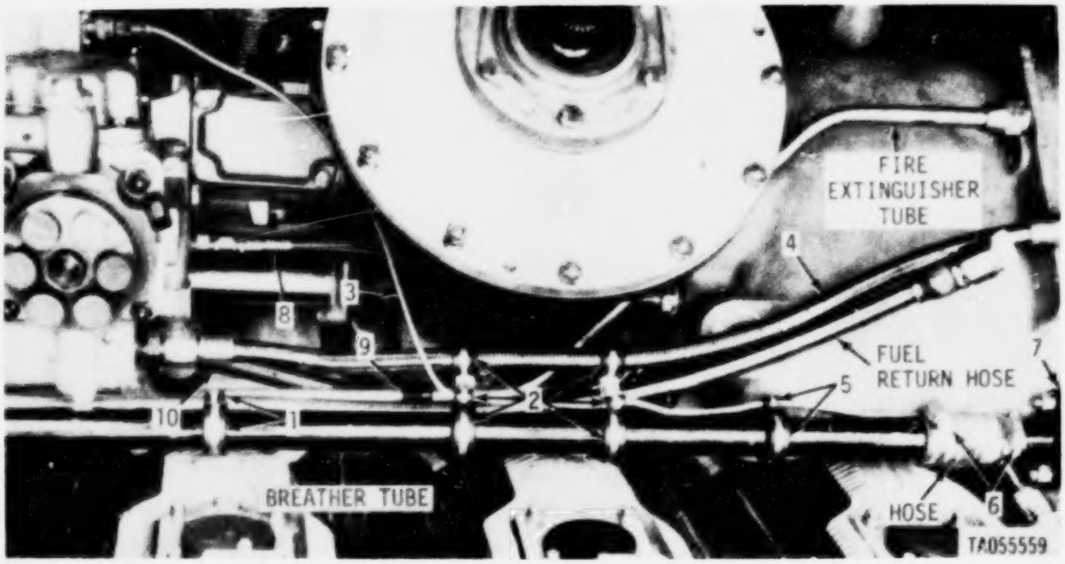
clamps (5) securing the electrical lead to the breather tube. Disconnect electrical lead (3) at fuel injection pump and remove lead. Loosen two hose clamps (6) and remove breather tube clamps and hose. Remove two self-locking nuts and remove crankcase breather tube adapter (7). Remove and discard gasket.

c. Disconnect fuel injection pump oil inlet hose (7, fig. 3-52) at injection pump and at damper housing and remove hose. Remove self-locking nut securing fire extinguisher tube cushioned clamp and turbosupercharger oil inlet hose cushioned clamp to front fan drive housing and remove clamps and fire extinguisher tube (8). Disconnect and remove turbosupercharger oil inlet hose (9) from elbow in damper and filter housing. Remove elbow (10).

c.1. Disconnect fuel injection pump oil inlet hose (8, fig. 3-52.1) at injection pump and at damper housing and remove hose. Remove self-locking nut securing fire extinguisher tube cushioned clamp (9) and turbosupercharger oil inlet hose cushioned clamp to front fan drive housing and remove clamps and fire extinguisher tube. Disconnect and remove turbosupercharger oil inlet hose (10) from elbow in damper and filter housing.

3-20. Turbosupercharger Base, Supports, and Tie Rods.

a. Remove four capscrews and lockwashers and remove right turbosupercharger mounting base (fig. 3-53). Remove left turbosupercharger base in the same manner. Remove two capscrews, lockwashers and one tie rod clamp and remove tie rod,



1 Cushioned clamp
2 Cushioned clamp
3 Electrical lead
4 Fuel inlet hose
5 Cushioned clamp
6 Hose clamp
7 Breather tube adapter
8 Fuel injection pump oil inlet hose
9 Cushioned clamp
10 Turbosupercharger oil inlet hose

Figure 3-52.1. Removing or installing electrical lead, crankcase breather tube, injection pump oil inlet hose, turbosupercharger oil inlet hose and fire extinguisher tube, model AVDS-1790-2DR engine.

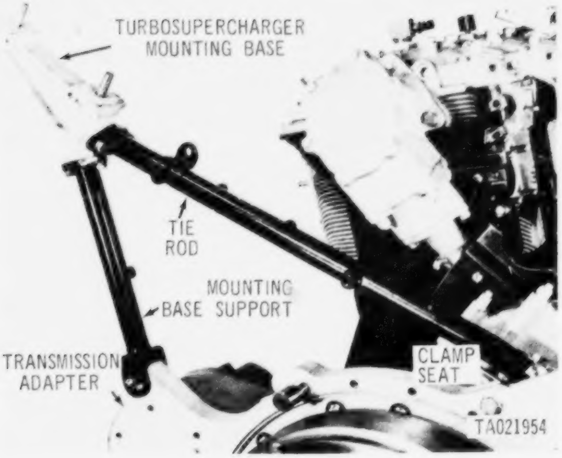

TURBOSUPERCHARGER
MOUNTING BASE
TIE
ROD
MOUNTING
BASE SUPPORT
TRANSMISSION
ADAPTER
CLAMP
SEAT
TA021954

Figure 3-53. Removing or installing turbosupercharger mounting base, tie rod and base support.

tie rod clamp and tie rod clamp seat. Remove cotter pin, slotted nut and bolt and remove right turbosupercharger mounting base support from transmission adapter.

b. Remove left turbosupercharger support in a manner similar to paragraph *a.* above, except also remove the oil filler tube upper support (fig. 3-53.1).

3-21. Throttle Control and Fuel Shut-off Rods, and Throttle Lever

a. Remove cotter pin and flat washer (1, fig. 3-54) and remove manual fuel shut-off rod (2). Disconnect and remove manual fuel shut-off spring (3) from spring bracket (4) and injection pump lever. Remove two capscrews (5) and remove shut-off spring bracket.

a.1. Remove cotter pin and flatwasher (1, fig. 3-54.1) and remove manual fuel shut-off rod (2). Disconnect and remove manual fuel shut-off rod spring (3) from spring bracket (4) and injection pump lever. Remove three capscrews and lockwashers (5) and remove spring bracket from fuel injection pump.

b. Remove two self-locking nuts, machine bolts and one flat washer (1, fig. 3-55) and remove throttle rod (2) from injection pump lever and intermediate lever (3). Remove self-locking nut and machine bolt (4) and remove adjustable rod (5) from intermediate lever. Disconnect and remove throttle lever return spring (6) from return spring

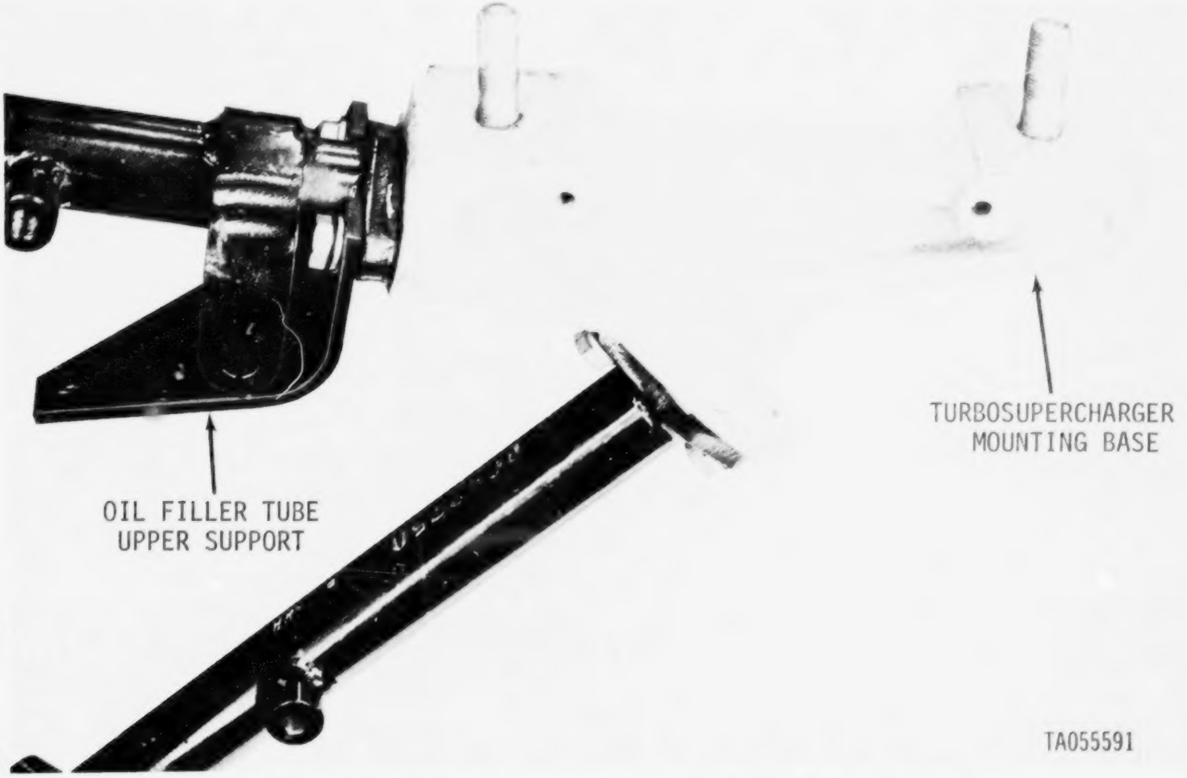
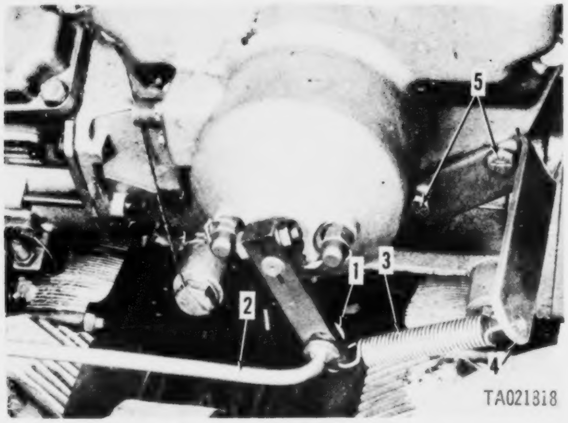
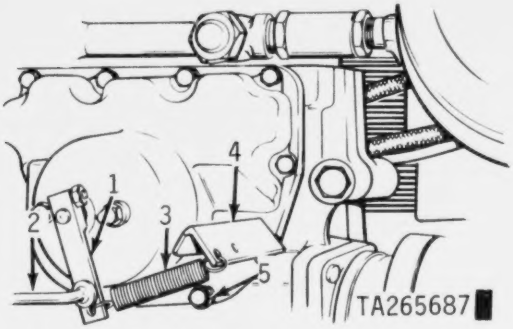

OIL FILLER TUBE
UPPER SUPPORT
TURBOSUPERCHARGER
MOUNTING BASE
TA055591

Figure 3-53.1. Oil filler tube upper support, model AVDS-1790-2DR engine.



1 Cotter pin and flat washer
2 Manual fuel shut-off rod
3 Manual fuel shut-off spring
4 Shut-off spring bracket
5 Capscrews

Figure 3-54. Removing or installing fuel shut-off rod, model AVDS-1790-2C and AVDS-1790-2D engines.



1 Cotter pin and flat washer
2 Manual fuel shut-off rod
3 Manual fuel shut-off rod spring
4 Spring bracket
5 Capscrew and lockwasher

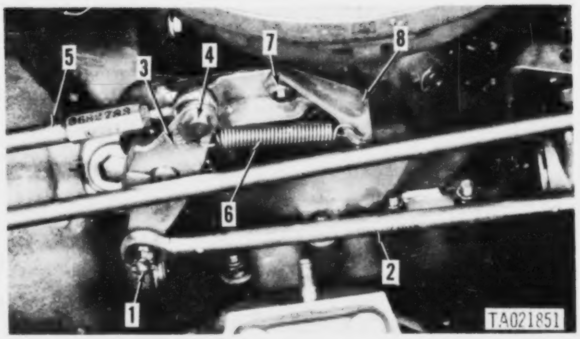
Figure 3-54.1. Removing or installing fuel shut-off rod, model AVDS-1790-2DR engine.

bracket and intermediate lever.

b.1. Remove self-locking nut and machine bolt (1, fig. 3-55.1) and remove adjustable rod (2). Remove self-locking nut, machine bolt and flat washer (3) at injection pump lever. Remove self-locking nut, machine bolt and flat washer (4) and remove throttle rod (5)

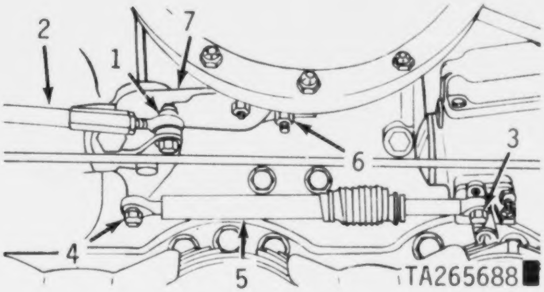
c. Remove three self-locking nuts (7, fig. 3-55) securing return spring bracket to the front fan housing. Remove return spring bracket (8), lever support, shaft, and intermediate throttle lever (3) as an assembly.

c.1. Remove three self-locking nuts and flat washers (6, fig. 3-55.1) and remove intermediate throttle lever support (7), shaft, and throttle lever as an assembly.



1 Self-locking nut, flat washer and machine bolt
2 Throttle rod
3 Intermediate throttle lever
4 Self-locking nut and machine bolt
5 Adjustable rod
6 Throttle lever return spring
7 Self-locking nut
8 Return spring bracket

Figure 3-55. Removing or installing intermediate throttle lever support and throttle rods, model AVDS-1790-2C and AVDS-1790-2D engines.



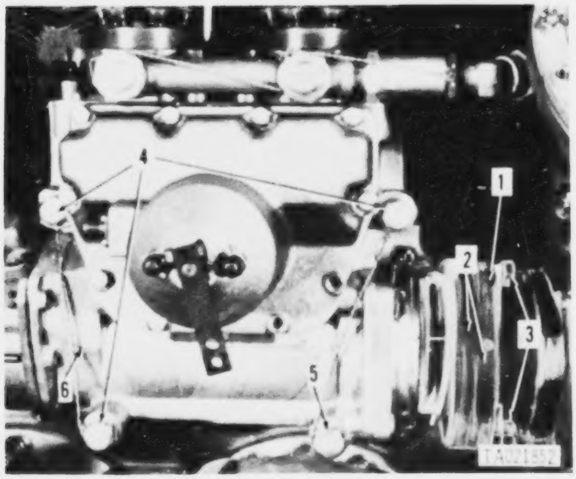
1 Self-locking nut and machine bolt
2 Adjustable rod
3 Self-locking nut, machine bolt and flat washer
4 Self-locking nut, machine bolt and flat washer
5 Throttle rod
6 Self-locking nut and flat washer
7 Intermediate throttle lever support

Figure 3-55.1. Removing or installing intermediate throttle lever support and throttle rods AVDS-1790-2DR engine.

3-22. Fuel Injection Pump

a. Turn engine flywheel using splined wrench, Part No. 10882747 (fig. 2-42) until fuel injection pump drive coupling (1, fig. 3-56) is positioned as shown in fig. 3-56. Stamp identification marks (2) on both coupling sleeves. Remove four machine bolts, lockwashers and lock plates (3) and separate coupling sleeves.

a.1. Install power takeoff coupling on spur gearshaft and secure with flat washer and self-locking nut (fig. 2-148.2). Install holding bar and puller assembly on coupling (fig. 2-148.2). Turn crankshaft until fuel injection pump drive coupling (1, fig. 3-56) is positioned as shown in figure 3-56. Stamp identification marks (2) on both cou-


1
2
3
4
5
6
TA021552

1 Fuel injection pump drive coupling
2 Identification marks
3 Machine bolt, lockwasher and lock plate
4 Mounting bolt and washer
5 Mounting bolt and washer
6 Fuel injection pump

Figure 3-56. Removing or installing fuel injection pump.

pling sleeves. Remove four machine bolts, lockwashers and lock plates (3) and separate coupling sleeves.

NOTE

> The fuel injection pump coupling sleeves and hubs must be identified with identification marks to prevent mismating of parts. The sleeves and hubs are matched for each assembly and must not be interchanged between assemblies.

b. Cut locking wire and remove three injector pump mounting bolts and plain washers (4). Loosen mounting bolt (5) until threads are free. Bolt cannot be removed until fuel injection pump (6) is removed from engine. Remove pump from mounting base and remove bolt and plain washer (5) from pump.

3-23. Shrouds, Cylinder Deflectors, and Nozzle Holder Assemblies

a. Remove two machine screws (fig. 3-57) and remove lower right camshaft shroud. Remove machine screw and remove upper right camshaft shroud. Remove left shrouds in the same manner.

b. Remove machine screw (fig. 3-58) from lower right engine shroud. Remove two machine screws (fig. 3-59) and remove base shroud and lower right rear shroud. Remove machine screw, lockwasher and spring clip from crankcase. Remove left lower shroud, base shroud and clip in the same manner.

c. Remove five self-locking nuts and washers (fig. 3-60) from hooks and remove five intercylinder cylinder head deflectors and hooks. Remove five self-

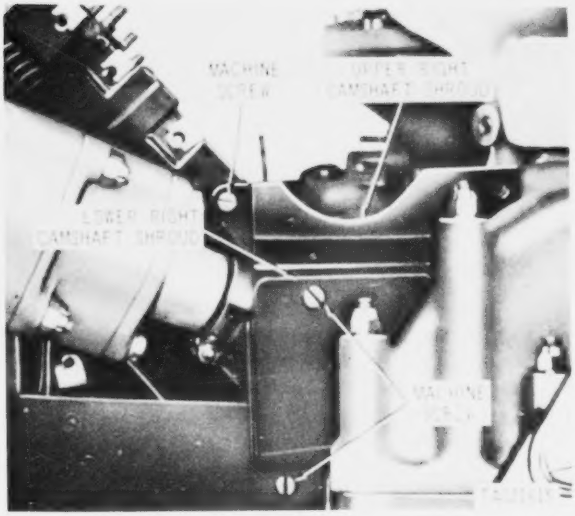

MACHINE SCREW
UPPER RIGHT CAMSHAFT SHROUD
LOWER RIGHT CAMSHAFT SHROUD
MACHINE SCREW

Figure 3-57. Removing or installing camshaft drive shrouds – right side.

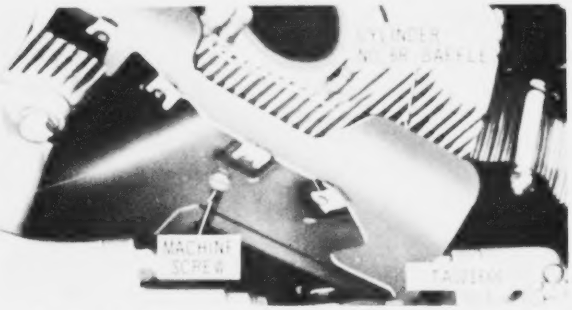

CYLINDER NO. 5R BAFFLE
MACHINE SCREW

Figure 3-58. Disconnecting or connecting lower right engine shroud.

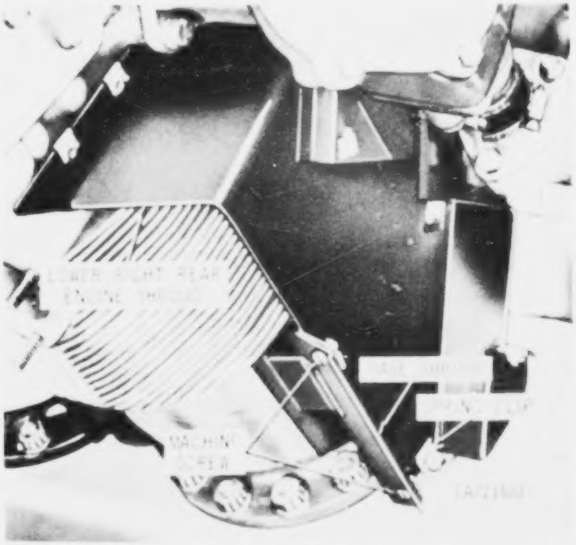

LOWER RIGHT REAR ENGINE SHROUD
BASE SHROUD
SPRING CLIP
MACHINE SCREW

Figure 3-59. Removing or installing lower right engine shroud and base shroud.

locking nuts and flat washers from right intercylinder deflector hooks. Remove left deflectors and hooks and intercylinder deflector nuts and washers in the same manner.

d. Remove five intercylinder deflector hoooks (fig. 3-61) and remove five right intercylinder deflectors. Remove left intercylinder deflector hooks and deflectors in the same manner.

e. Loosen and remove fuel injector nozzles and holder assemblies as shown in fig. 2 85. Remove and discard flat washers (gasket) (fig. 3-62) and preformed packing.

NOTE

In stubborn cases, when the nozzle is heavily carboned, remove the fuel inlet connector from the nozzle body and remove the nozzle body. Remove the nozzle retainer using wrench socket, Part No. 11610171. Turn the shaft of puller assembly, Part No. 12275805 counterclockwise to the end of the thread. Install puller over capnut and rest on nozzle insert. Turn puller shaft clockwise and engage capnut threads until puller shaft bottoms. Using open end wrench, turn puller plain nut clockwise (fig. 2-85.1) to remove capnut and associated parts.

3-24. Camshaft

NOTE

Both the left and right camshafts are removed in the same manner. For instructional purposes, the right camshaft has been used for typical procedures.

a. Remove twenty four machine bolts and flat washers under supports (1, fig. 3-63) attaching twelve injector clamp supports (2) to valve adjusting screw access covers (3), remove supports and covers. Remove twenty four bolts and flat washers (4) attaching twelve valve adjusting screw access covers to rocker arm covers and remove access covers. Remove and discard twenty four access cover plate gaskets (5).

NOTE

The cylinder and valve rocker arm covers are machined as an assembly. Each rocker arm cover must be kept with its mating cylinder to insure camshaft bearing alinement and running clearance. Identifying numbers are used to prevent mismatching of parts (fig. 3-64).

b. Remove three capscrews (fig. 3-65) attaching right lifting eye to rocker arm cover and cylinder No. 1R and remove three capscrews attaching each intercylinder hose flange to remaining covers and cylinders on right side of engine. Slide flanges and lifting eye away from rocker arm covers and cylinders.

NOTE

Model AVDS-1790-2DR engines are not equipped with lifting eyes at cylinder Nos. 1R and 1L. Intercylinder hose flanges are used at these locations.

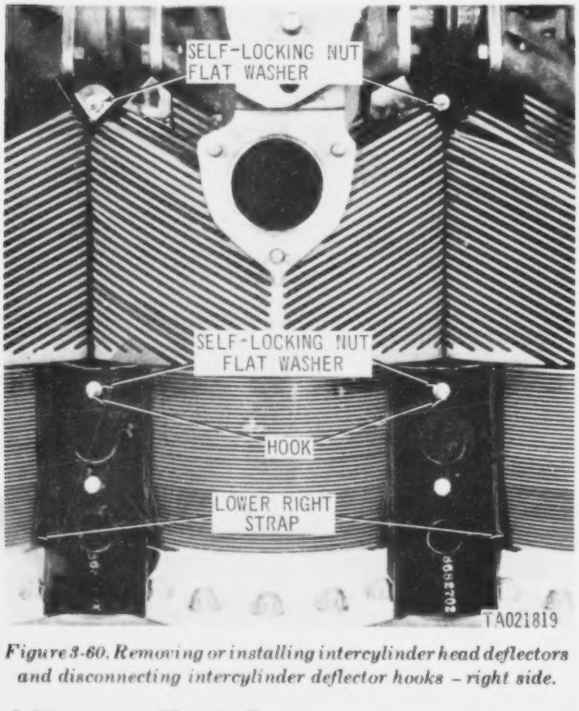


Figure 3-60. Removing or installing intercylinder head deflectors and disconnecting intercylinder deflector hooks – right side.

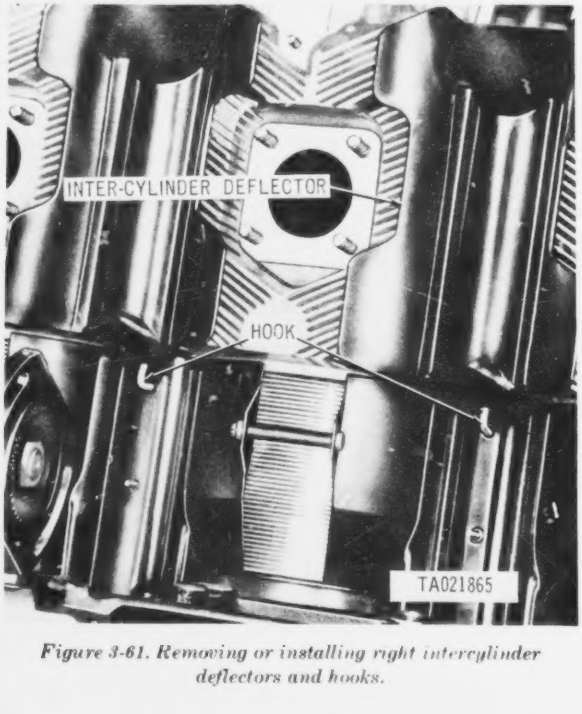


Figure 3-61. Removing or installing right intercylinder deflectors and hooks.

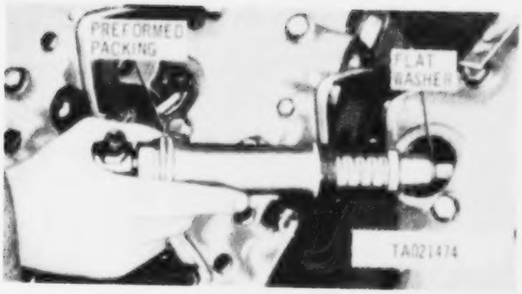
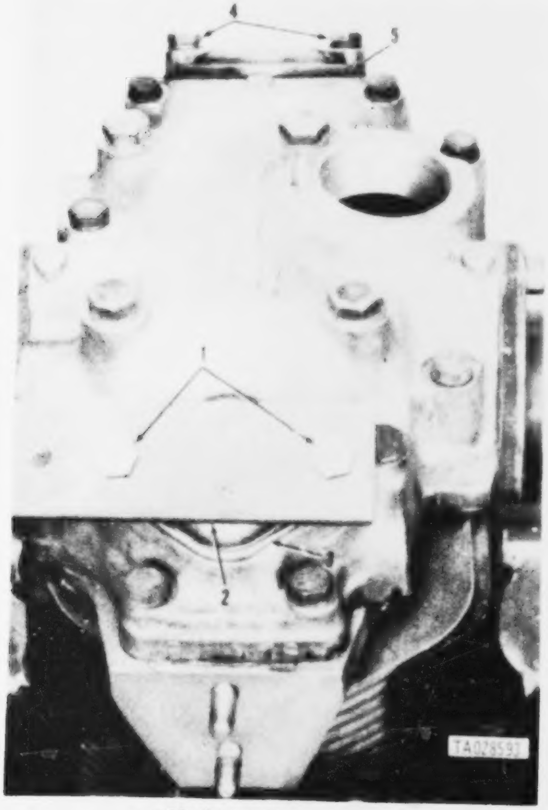

PREFORMED PACKING
FLAT WASHER
TA021474

Figure 3-62. Removing or installing injector nozzle and holder assembly.


4
5
1
2
TA028592

1 Machine bolt
2 Injector tube clamp supports
3 Access cover
4 Bolt and washer
5 Gasket

Figure 3-63. Removing or installing valve adjusting screw access cover.

c. Remove capscrew, flat washer and lockwasher (1, fig. 3-66) attaching right camshaft gear housing to No. 6R rocker arm cover. Do not remove two capscrews, lockwashers and flat washers (2) attaching housing (3) to cylinder (4) until camshaft is removed.

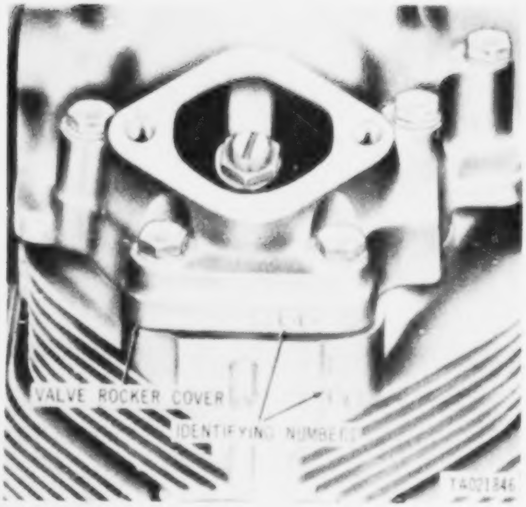

VALVE ROCKER COVER
IDENTIFYING NUMBERS
TA021846

Figure 3-64. Location of valve rocker arm cover cylinder identifying marks.

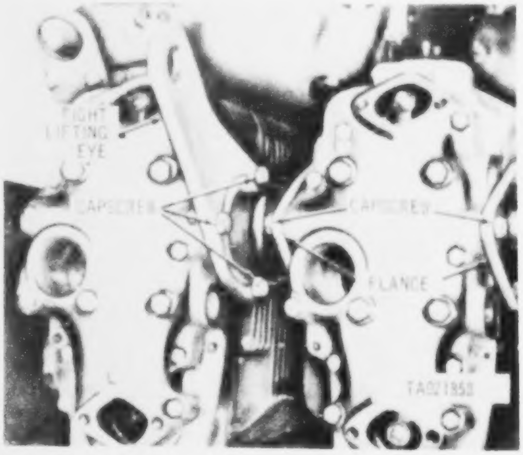
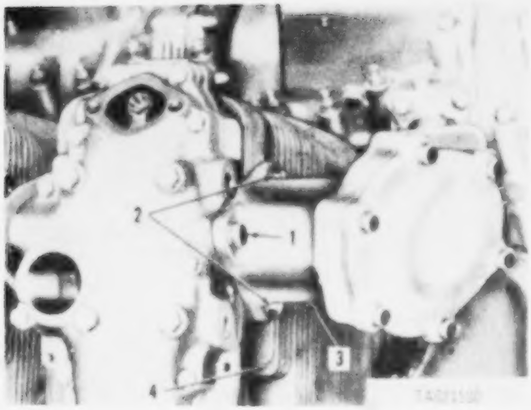

RIGHT LIFTING EYE
CAPSCREW
CAPSCREW
FLANGE
TA021853

Figure 3-65. Disconnecting or connecting right front lifting eye and intercylinder hose flange, model AVDS-1790-2C and AVDS-1790-2D engines.

NOTE

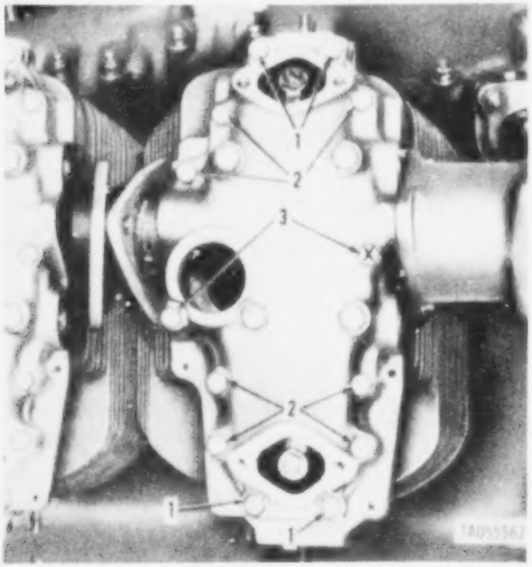
One valve rocker arm cover retaining capscrew and flat washer, and the associated machining, have been eliminated from the cylinder assembly on late engines. The capscrew and flat washer that has been eliminated is marked X on figure 3-67.

d. Remove four machine bolts and flat washers (1, fig. 3-67), seven machine bolts and flat washers (2) and two capscrews and flat washers (3) securing rocker arm cover to cylinder. Before removing the



1 Capscrew, flat washer and lockwasher
2 Capscrew, lockwasher and flat washer
3 Housing
4 Cylinder

Figure 3-66. Disconnecting or connecting right camshaft gear housing at cylinder 6R rocker arm cover.



1 Machine bolt and flat washer
2 Machine bolt and flat washer
3 Capscrew and flat washer

Figure 3-67. Removing or installing rocker arm cover bolts and capscrews.

remaining four rocker arm cover bolts, the tension on valve rocker arm, caused by valve springs, must be released. Turn Model AVDS-1790-2C and AVDS-1790-2D engines using splined wrench, Part No. 10882747 (fig. 2-42). Turn Model AVDS-1790-2DR engine using holding bar and puller assembly (fig. 2-148.2). Turn engine until valve rocker arm rollers are on camshaft base circle, or until both valves are closed, to relieve tension before removing the cover. Check both cylinder No. 1R valve rocker arms for relief of tension by moving arms (fig. 3-68) up and down. If clearance cannot be felt, turn engine until clerance is evident. When clearance is felt between both adjusting screw pads and valve stems, the rocker arm rollers are on the camshaft base circle, and valves are completely closed. Remove remaining four bolts (fig. 3-68) and packings with retainers and remove rocker arm covers as shown in figure 3-69. Remove remaining 11 covers in the same manner.

NOTE

Cylinders are equipped with replaceable camshaft bearings. The bearing half in the cover should remain with the cover.

e. Remove five hex-head bolts and flat washers (fig. 3-70) and remove right camshaft gear housing cover gasket (fig. 3-71). Remove camshaft drive gearshaft oil transfer plug retaining ring.

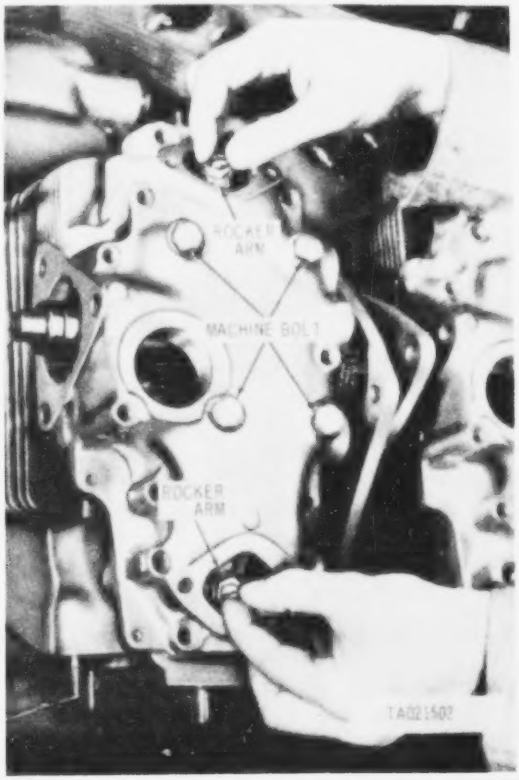


Figure 3-68. Checking valve clearance and removing cover bolts.

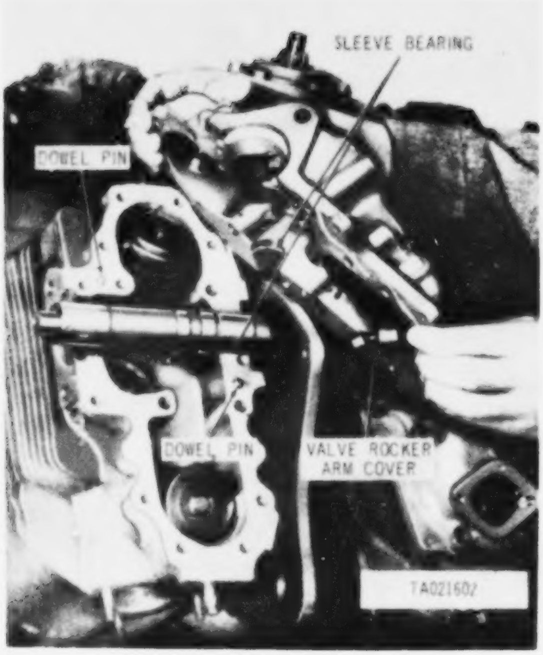

SLEEVE BEARING
DOWEL PIN
DOWEL PIN
VALVE ROCKER ARM COVER
TA021602

Figure 3-69. Removing or installing valve rocker arm cover.

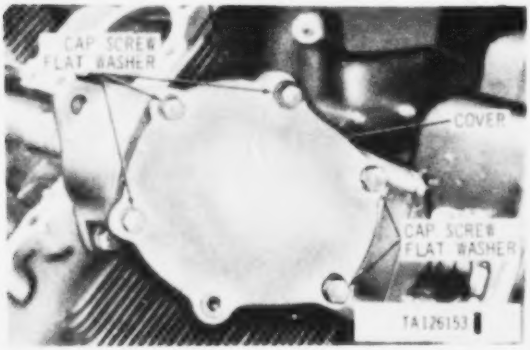

CAP SCREW FLAT WASHER
COVER
CAP SCREW FLAT WASHER
TA126153

Figure 3-70. Removing or installing right camshaft gear housing cover.

f. Install mechanical puller Part No. 8761297 (fig. 3-72) into threaded end of camshaft drive gearshaft oil transfer plug and remove oil transfer plug. Install mechanical puller Part No. 8761297 (fig. 3-73) into threaded end of camshaft drive shaft and remove camshaft drive shaft. Loosen two camshaft gear housing drain tube hose clamps (fig. 3-74). Remove two capscrews, flat washers and lockwashers attaching camshaft gear housing to cylinder 6R and remove camshaft and associated parts as a unit (fig. 3-75). Remove and discard camshaft gear housing gasket.

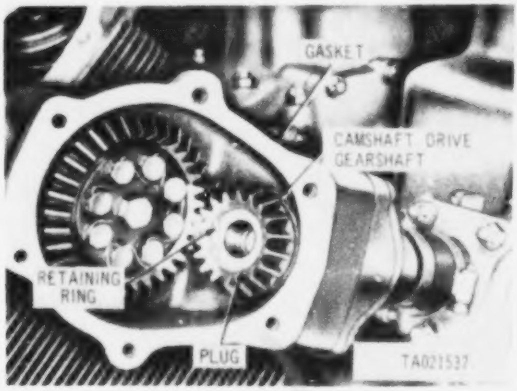

GASKET
CAMSHAFT DRIVE GEARSHAFT
RETAINING RING
PLUG
TA021537

Figure 3-71. Removing or installing camshaft drive gearshaft oil transfer plug retaining ring.

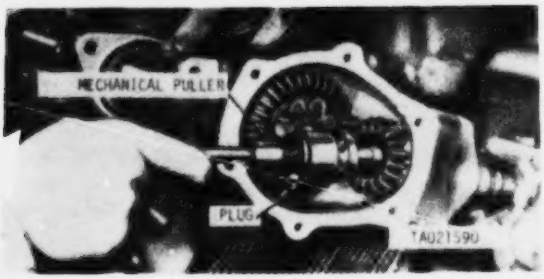

MECHANICAL PULLER
PLUG
TA021590

Figure 3-72. Removing or installing camshaft drive gearshaft oil transfer plug.

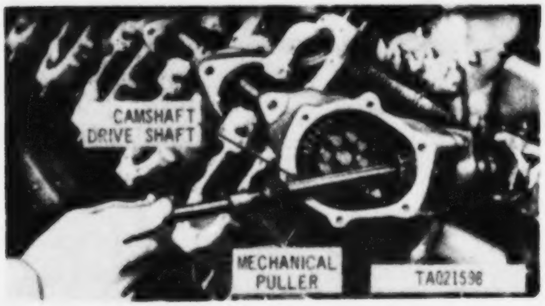

CAMSHAFT DRIVE SHAFT
MECHANICAL PULLER
TA021598

Figure 3-73. Removing or installing camshaft drive shaft.

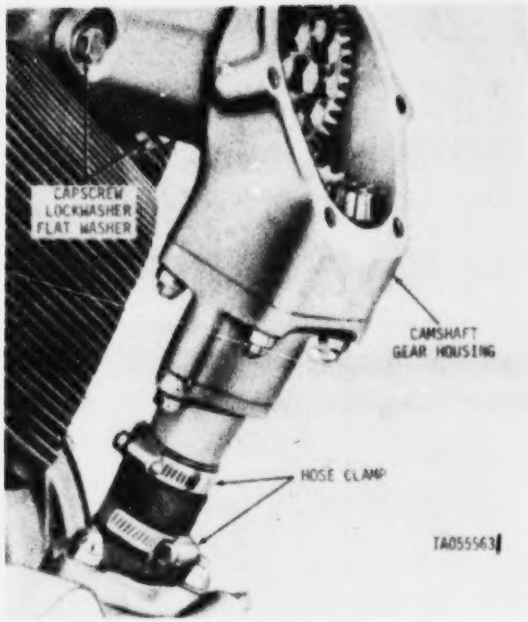

CAPSCREW
LOCKWASHER
FLAT WASHER
CAMSHAFT GEAR HOUSING
HOSE CLAMP
TA055563

Figure 3-74. Disconnecting or connecting right camshaft gear housing at cylinder 6R.

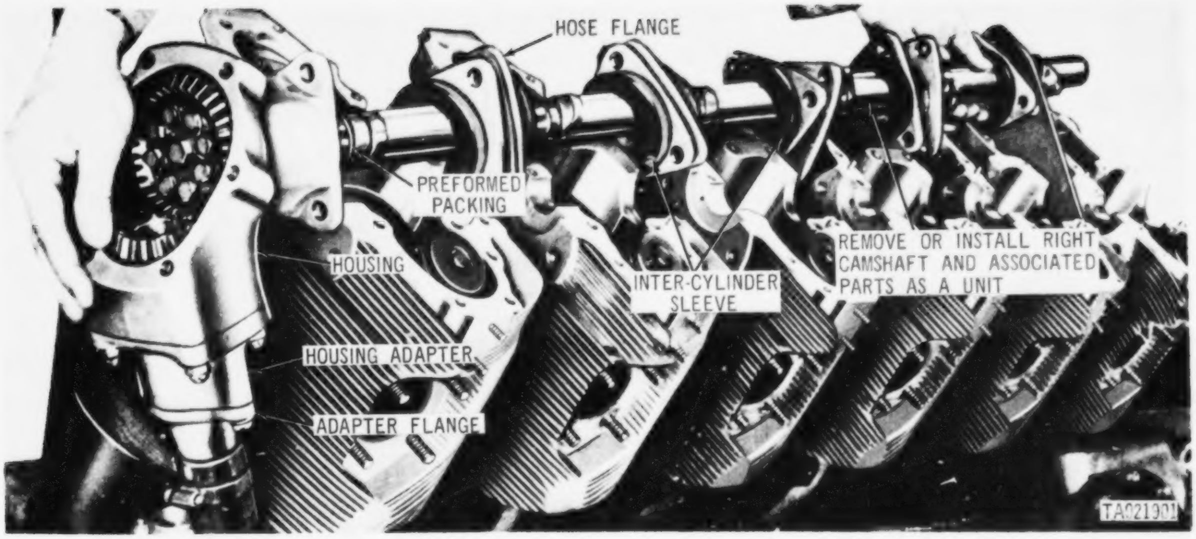

HOSE FLANGE
PREFORMED PACKING
HOUSING
HOUSING ADAPTER
ADAPTER FLANGE
INTER-CYLINDER SLEEVE
REMOVE OR INSTALL RIGHT CAMSHAFT AND ASSOCIATED PARTS AS A UNIT
TA021901

Figure 3-75. Removing right camshaft.

3-25. Front Fan Drive Housing with Clutch Assembly and Mounting Base and Fuel Injection Pump Mounting Base

a. Loosen two hose clamps (fig. 3-76) on horizontal fan drive shaft front and rear covers. Remove two self-locking nuts and flat washers attaching rear horizontal fan drive shaft cover adapter to rear fan drive housing. Remove two self-locking nuts and flat washers attaching front cover adapter to front fan drive housing. Separate cover adapter (fig. 3-77) from front and rear fan drive housing and push the front and rear fan drive shaft covers together to expose the preformed packings. Remove retaining ring from front fan drive shaft spline groove using retaining ring pliers (fig. 3-78) and push horizontal fan drive shaft into front fan drive housing (fig. 3-79) until opposite end of shaft is exposed (fig. 3-80).

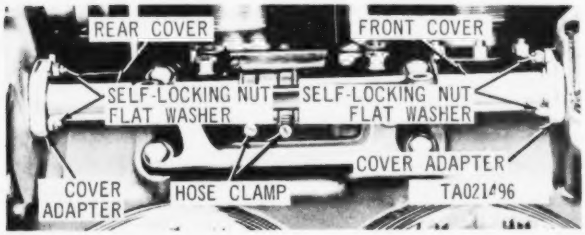

REAR COVER
FRONT COVER
SELF-LOCKING NUT
FLAT WASHER
SELF-LOCKING NUT
FLAT WASHER
COVER ADAPTER
COVER ADAPTER
HOSE CLAMP
TA021496

Figure 3-76. Disconnecting or connecting horizontal fan drive shaft front and rear cover adapters.

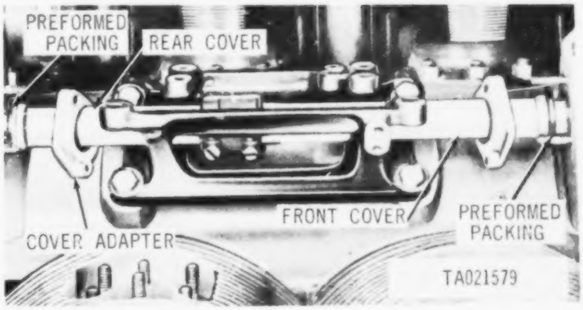

PREFORMED PACKING
REAR COVER
FRONT COVER
PREFORMED PACKING
COVER ADAPTER
TA021579

Figure 3-77. Disconnecting or connecting front and rear fan drive covers.

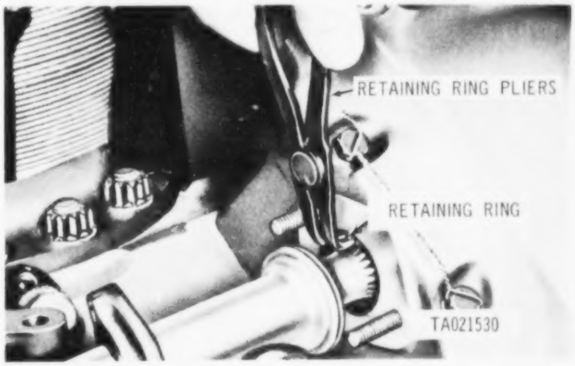

RETAINING RING PLIERS
RETAINING RING
TA021530

Figure 3-78. Removing or installing horizontal fan drive shaft retaining ring using ring pliers.

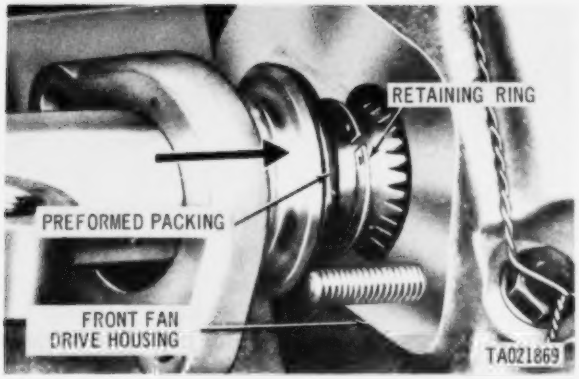

RETAINING RING
PREFORMED PACKING
FRONT FAN DRIVE HOUSING
TA021869

Figure 3-79. Positioning horizontal fan drive shaft in rear fan drive housing.

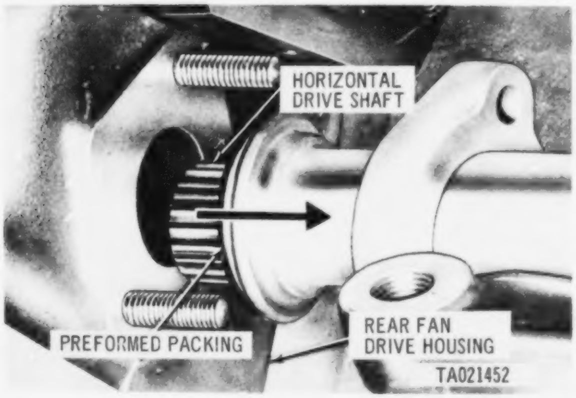

HORIZONTAL DRIVE SHAFT
PREFORMED PACKING
REAR FAN DRIVE HOUSING
TA021452

Figure 3-80. Horizontal fan drive shaft positioned for removal of front fan drive housing.

b. Remove nine self-locking nuts and flat washers (fig. 3-81) attaching front fan drive housing to mounting base. One self-locking nut at stud was removed when fire extinguisher tube was removed (fig. 3-52). Cut locking wire and remove two capscrews and flat washers (fig. 3-82) attaching front fan drive housing to mounting base.

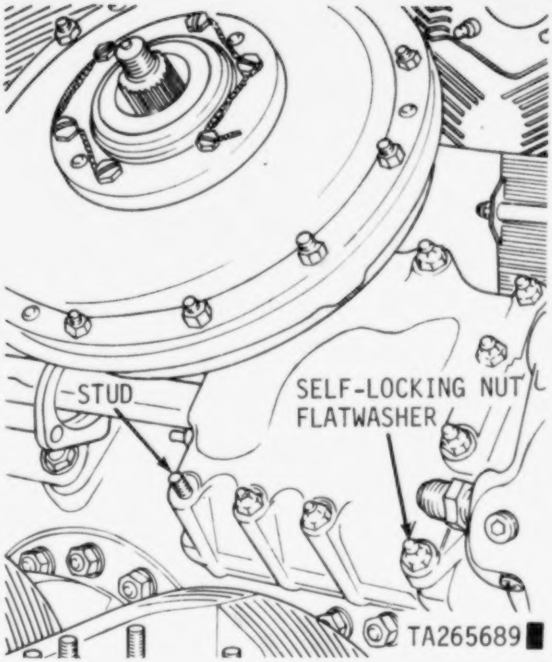

STUD
SELF-LOCKING NUT
FLATWASHER
TA265689

Figure 3-81. Removing or installing front fan drive housing attaching parts — front view.

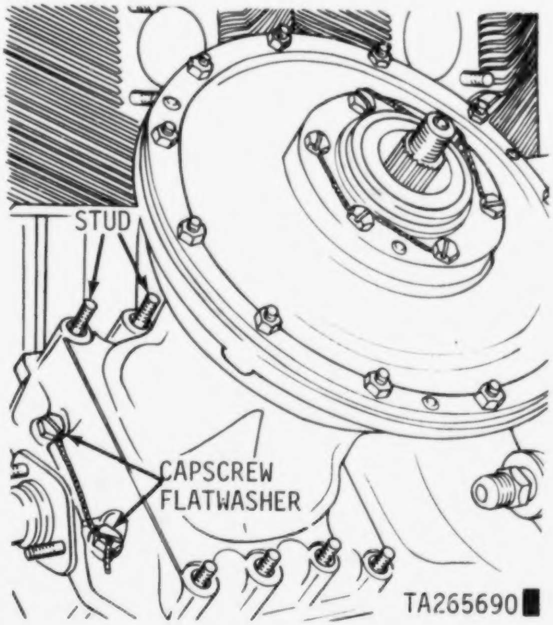

STUD
CAPSCREW
FLATWASHER
TA265690

Figure 3-82. Removing or installing front fan drive housing attaching parts — rear view.

c. Install improvised front fan drive housing lifting tool (fig. 2-1) on vertical drive shaft (fig. 3-83) and lift front fan drive housing and clutch assembly with attached horizontal fan drive shaft from the mounting base assembly. Remove fan drive shaft, cover, and cover adapter. Remove and discard preformed packings.

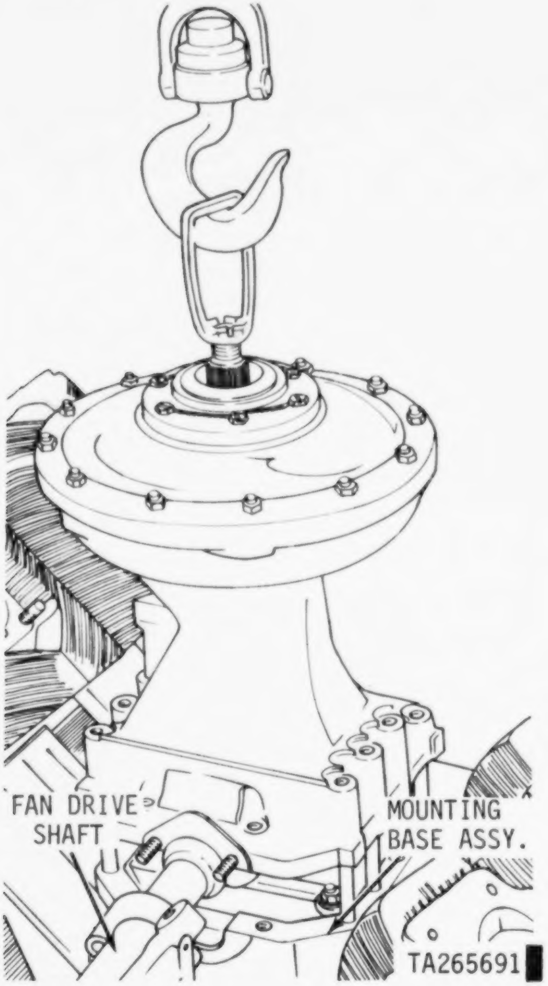
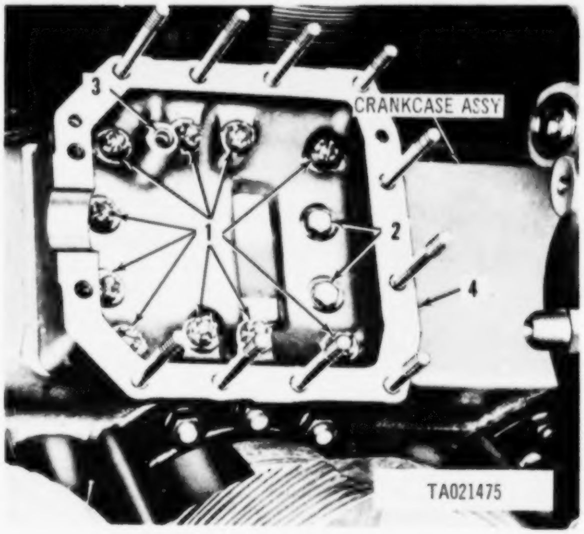


Figure 3-83. Removing or installing front fan drive housing and clutch assembly using improvised lifting tool.

d. Remove ten cotter pins, slotted nuts and flat washers (1, fig. 3-84) and two capscrews and flat washers (2) securing front fan drive housing mounting to crankcase. Remove and discard preformed packing (3) from oil transfer tube counterbore in mounting base assembly (4) or from oil transfer tube in fan drive housing. Remove front fan drive housing mounting base assembly (4) from crankcase assembly and remove and discard preformed packing from oil transfer tube (fig. 3-85).



1 Slotted nut and flat washer
2 Capscrew and flat washer
3 Preformed packing
4 Mounting base assembly

Figure 3-84. Removing or installing front fan drive housing mounting base assembly.

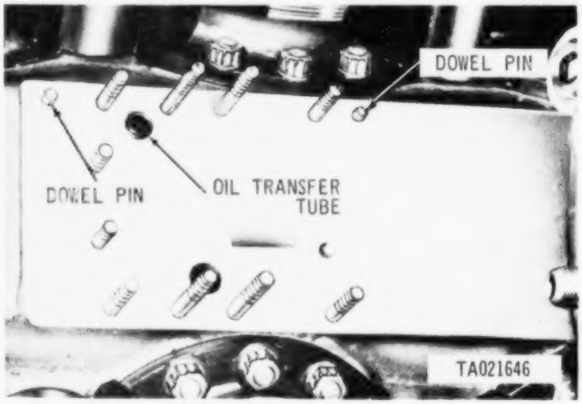


Figure 3-85. Location of preformed packing on oil transfer tube in crankcase assembly.

e. Remove and discard preformed packing (fig. 3-86) from oil transfer tube in fuel injection pump mounting base. Remove four bolts and lockwashers and remove mounting base from crankcase assembly. Remove and discard preformed packing from oil transfer tube (fig. 3-87).

3-26. Rear Fan and Accessory Drive Housing With Clutch Assembly and Mounting Base

a. Remove eight self-locking nuts and flat washers (fig. 3-88) attaching accessory drive housing to rear fan and accessory drive housing mounting base. Remove one self-locking nut, flat washer,

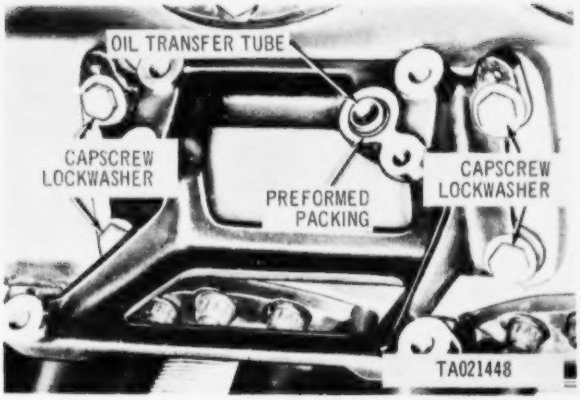

OIL TRANSFER TUBE
CAPSCREW
LOCKWASHER
PREFORMED
PACKING
CAPSCREW
LOCKWASHER
TA021448

Figure 3-86. Removing or installing fuel injection pump mounting base.

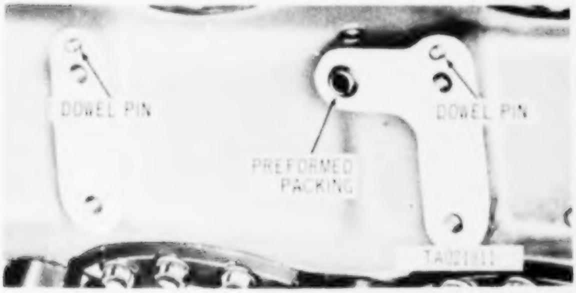

DOWEL PIN
DOWEL PIN
PREFORMED
PACKING
TA021811

Figure 3-87. Location of preformed packing at oil transfer tube for fuel injection pump mounting base.

and seal washer attaching accessory drive housing to rear fan and accessory drive housing mounting base. Remove five self-locking nuts and flat washers attaching rear fan drive housing to mounting base.

b. Remove the remaining 11 self-locking nuts and flat washers (1, fig. 3-89) attaching rear fan and accessory drive housing assembly to mounting base. Remove one self-locking nut, flat washer, and seal washer (2) attaching accessory drive housing to rear fan and accessory drive housing mounting base. Remove top two self-locking nuts and flat washers (3), securing the accessory drive housing to the fan drive housing, to provide for the attachment of fan and advance unit housing lifting sling — Part No. 10882945. Note that self-locking nut was removed from stud (4) when fire extinguisher tube was removed. Remove one self-locking nut and flat washer (5) from each side of the housing mounting base flange.

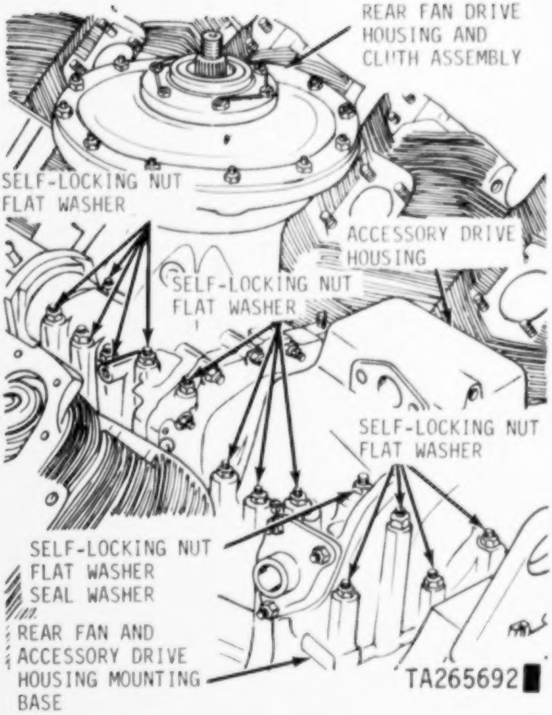
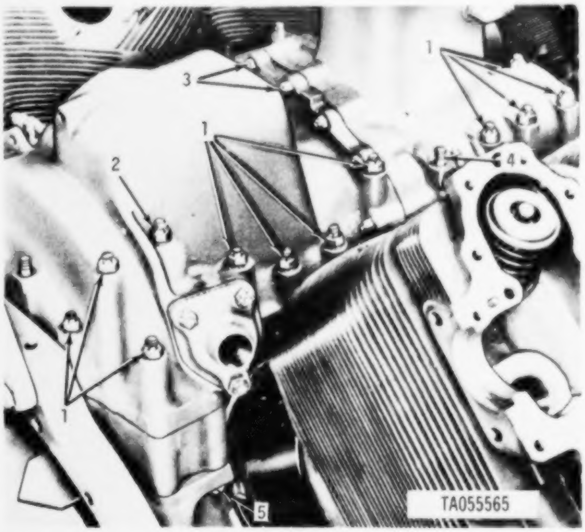

REAR FAN DRIVE
HOUSING AND
CLUTH ASSEMBLY
SELF-LOCKING NUT
FLAT WASHER
ACCESSORY DRIVE
HOUSING
SELF-LOCKING NUT
FLAT WASHER
SELF-LOCKING NUT
FLAT WASHER
SELF-LOCKING NUT
FLAT WASHER
SEAL WASHER
REAR FAN AND
ACCESSORY DRIVE
HOUSING MOUNTING
BASE
TA265692

Figure 3-88. Removing or installing attaching parts for rear fan and accessory drive housing assemblies – right side.


1
2
3
1
4
1
5
TA055565

1 Self-locking nut and flat washer
2 Self-locking nut, flat washer and seal washer
3 Self-locking nut and flat washer
4 Stud
5 Self-locking nut and flat washer

Figure 3-89. Removing or installing attaching parts for rear fan and accessory drive housing assemblies – left side

c. Position fan and advance unit housing lifting sling — Part No. 10882945 (fig. 3-90) on rear fan drive housing and clutch assembly and secure lifting sling to rear fan and accessory drive housing with two self-locking nuts and flat washers (3, fig. 3-89). Secure lifting sling to fan vertical drive shaft with cooling fan attaching slotted nut. Adjust lifting eye in slot to assure balanced position of the assembly and remove by lifting housing straight up until housing clears the long mounting studs (fig. 3-91).

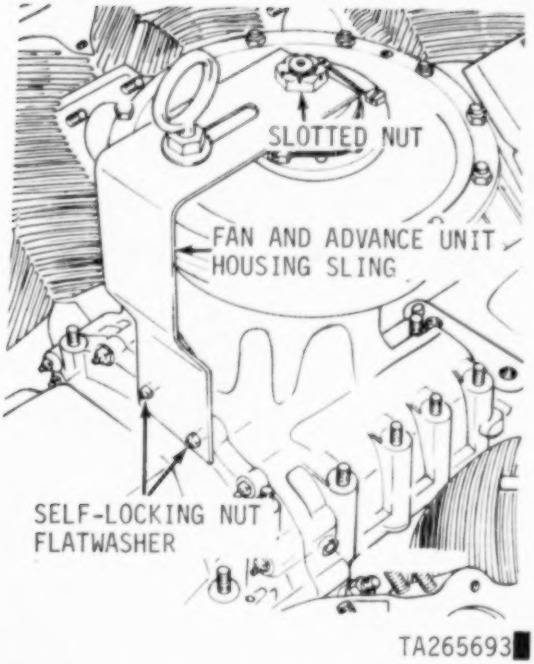

SLOTTED NUT
FAN AND ADVANCE UNIT HOUSING SLING
SELF-LOCKING NUT
FLATWASHER
TA265693

Figure 3-90. Removing or installing rear fan drive housing using fan and advance unit housing lifting sling.

d. Remove ten cotter pins, slotted nuts and flat washers (1, fig. 3-92) and six capscrews and flat washers (2) securing rear fan and accessory drive housing mounting base to the crankcase, and remove base (3). Remove and discard four preformed packings (4) from oil transfer counterbores in mounting base (or from oil transfer tubes in rear fan and accessory drive housing). Remove and discard three mounting base preformed packings in crankcase assembly (fig. 3-93).

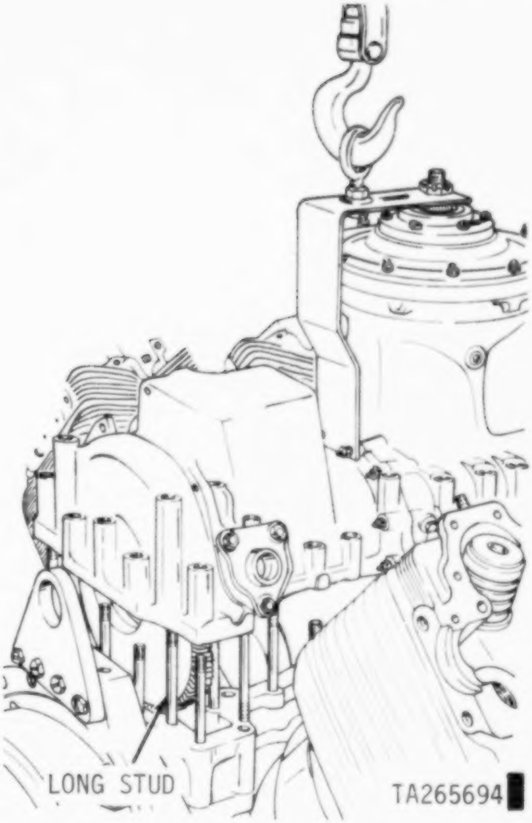
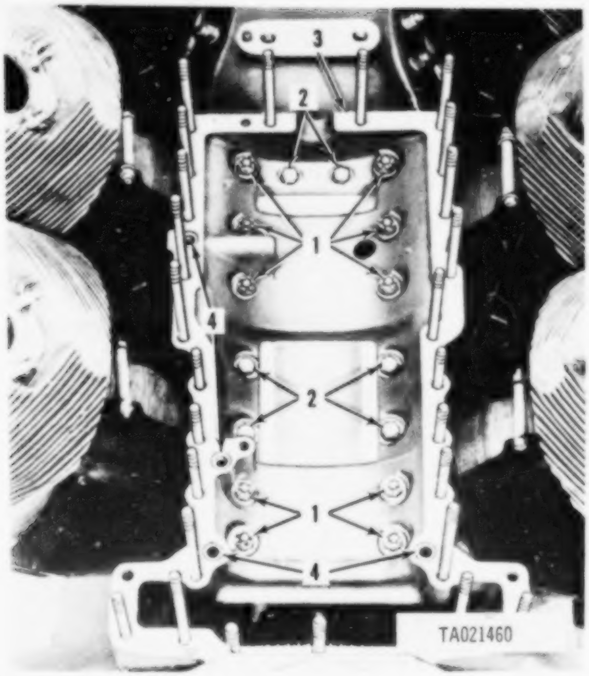

LONG STUD
TA265694

Figure 3-91. Removing or installing rear fan and accessory drive housing assembly.



1 Slotted nut and flat washer
2 Capscrew and flat washer
3 Rear fan and accessory drive housing mounting base
4 Preformed packing

Figure 3-92. Removing or installing rear fan and accessory drive housing mounting base.

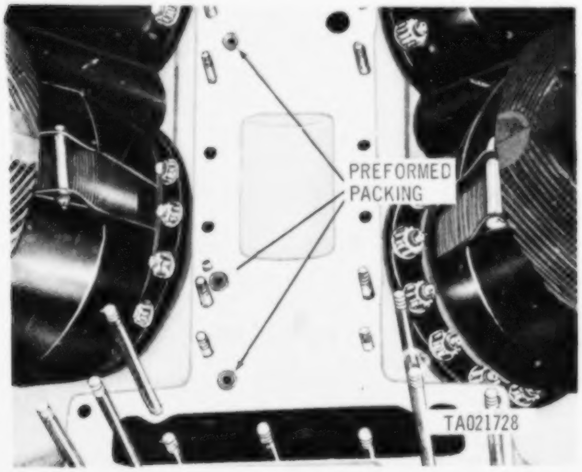
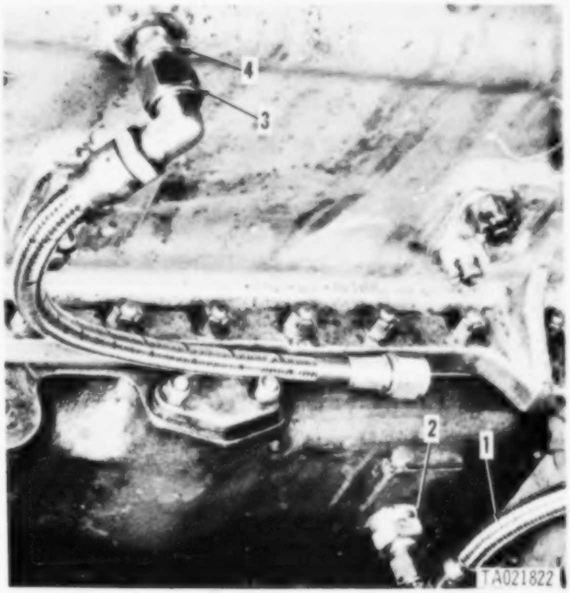


Figure 3-93. Location of preformed packing at oil transfer tubes in crankcase assembly — rear fan and accessory drive housing mounting base.

3-27. Oil Pan and Crankshaft Damper and Oil Filter Housing

a. Disconnect and remove generator oil drain hose (1, fig. 3-94) and adapter (2). Disconnect and remove generator oil inlet hose (3) and adapter (4).



1 Oil drain hose
2 Oil drain hose adapter
3 Oil inlet hose
4 Oil inlet hose adapter

Figure 3-94. Removing or installing generator oil inlet and drain hoses, model AVDS-1790-2C engine.

b. Remove two capscrews and lockwasher (fig. 3-95) and remove transmission cable connector bracket.

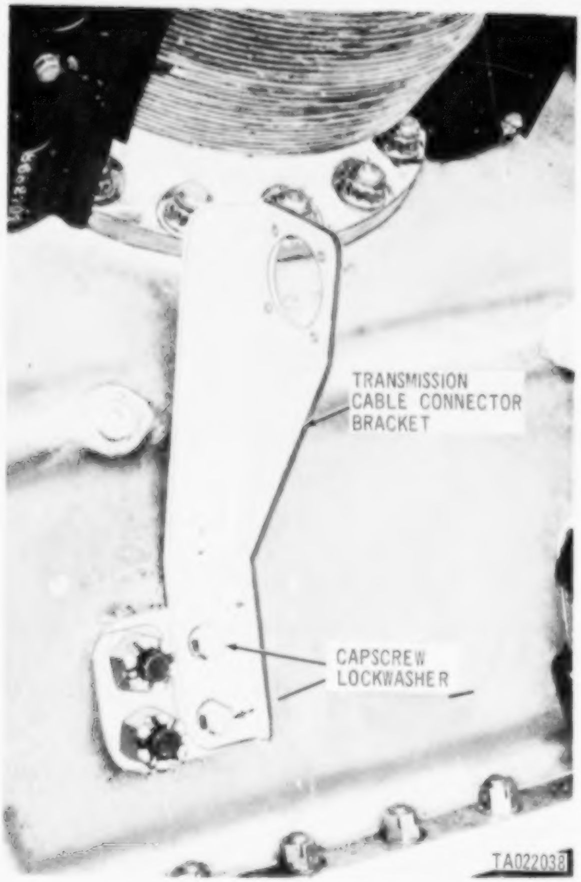


Figure 3-95. Removing or installing transmission cable connector bracket, model AVDS-1790-2C and AVDS-1790-2D engines.

c. Remove eight capscrews, lockwashers and flat washers (fig. 3-96) securing the oil pan to the crankcase. Remove nine capscrews, lockwashers and flat washers (1, fig. 3-97) securing the oil pan to the crankcase damper and oil filter housing (2). Remove 27 of 28 self-locking nuts and flat washers (3) on each side of the crankcase assembly. Leave one nut and washer installed on each side of the oil pan, near the center of the pan, to prevent the oil pan from falling and being damaged. Support the oil pan adequately before removing the two nuts and washers, then remove the oil pan (4). Remove oil pressure transmitter (5), bushing and elbow from crankcase.

c.1. Remove eight capscrews, lockwashers and flat washers (fig. 3-96) securing the oil pan to the crankcase. Remove nine capscrews, lockwashers and flat washers (1, fig. 3-97) securing the oil pan to the crankcase damper and oil filter housing (2). Remove 27 of 28 self-locking nuts and flat washers (3) on each side of the crankcase assembly. Leave one nut and washer installed on each side of the oil pan, near the center of the pan, to prevent the oil pan from falling and being damaged. Support the oil pan adequately before removing the two nuts and washers, then remove the oil pan (4). Remove high oil pressure transmitter (1, fig. 3-97.1), auxiliary generator high oil pressure switch (2), pipe elbow (3), tee (4), bushing (5), and pipe elbow (6) from crankcase. Remove nipple (7).

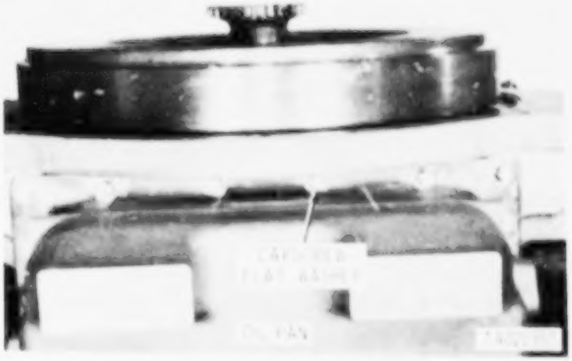
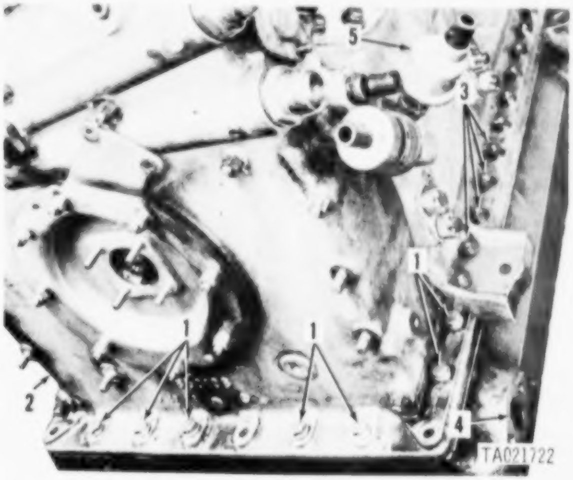


Figure 3-96. Removing or installing oil pan rear capscrews.



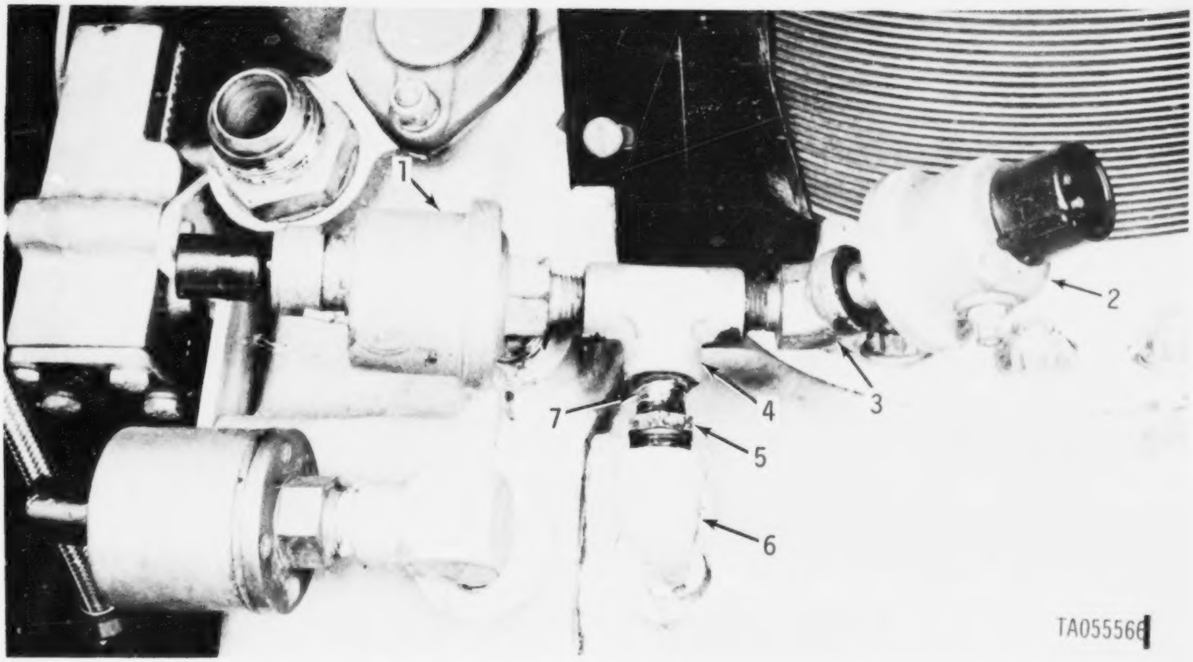
1 Capscrew, lockwasher and flat washer
2 Crankcase damper and oil filter housing
3 Self-locking nut and flat washer
4 Oil pan
5 Oil pressure transmitter

Figure 3-97. Removing or installing oil pan.

d. Remove eight self-locking nuts and flat washers (fig. 3-98) attaching crankcase damper and oil filter housing to crankcase assembly. Hook a suitable chain or hoist into lifting eyes. Take up housing weight on chain or hoist and separate housing from crankcase assembly.

NOTE

Do not allow housing to rest on studs after housing is separated from crankcase and oil transfer tubes. Extreme caution must



1 High oil pressure transmitter
2 Auxiliary generator high oil pressure switch
3 Pipe elbow
4 Tee
5 Bushing
6 Pipe elbow
7 Nipple

Figure 3-97.1. Removing or installing pressure transmitter and pressure switch, model AVDS-1790-2DR engine.

be taken to prevent damage to the oil pan and crankcase parting line machining surfaces on the damper and oil filter housing.

e. Remove damper and oil filter housing and remove and discard five crankcase to housing transfer tube, preformed packings (fig. 3-99).

3-28. Cylinder Air Deflectors, Cylinder Assemblies, Pistons and Pins

a. Remove twelve self-locking nuts, capscrews and spacers (fig. 3-100) attaching cylinder air deflectors to cylinder assemblies. Remove the four end cylinder air deflectors located at cylinder Nos. 1R, 1L, 6R and 6L. The ten lower cylinder deflector retaining straps are also secured by bolts (fig. 3-101).

b. Remove five volts (fig. 3-101) that attach the five lower cylinder deflector straps on each side of engine. Remove the ten lower cylinder straps and the ten lower cylinder deflector retainer straps (fig. 3-100) and remove all cylinder deflectors (fig. 3-101) from cylinder assemblies.

NOTE

Before removing cylinder assemblies, it will be necessary to check the breaking torque of the 14 nuts attaching each cylinder assembly to the crankcase assembly. This check is necessary to determine whether cylinder mounting flange studs have stretched. All stretched studs must be replaced.

c. Check breaking torque of the 14 nuts (fig. 3-102) securing cylinder assembly to crankcase assembly using box wrench Part No. 8761562 in combination with a torque wrench. When torque required to break a nut loose is less than 600 pound inches, remove nut, apply antiseize compound to stud, install nut and tighten to a torque of 600 to 660 pound inches. When nut does not tighten to the recommended torque, stud is stretching and must be replaced. Mark stud for replacement. Refer to paragraph 3-38*d* for instruction on replacement of studs.

d. After checking the breaking torque, remove all nuts (fig. 3-103) except one on each side of cylinder mounting flange. The remaining two nuts are removed after piston has been positioned for cylinder removal (*g* below).

NOTE

Before removing each cylinder assembly, the crankshaft must be turned to position

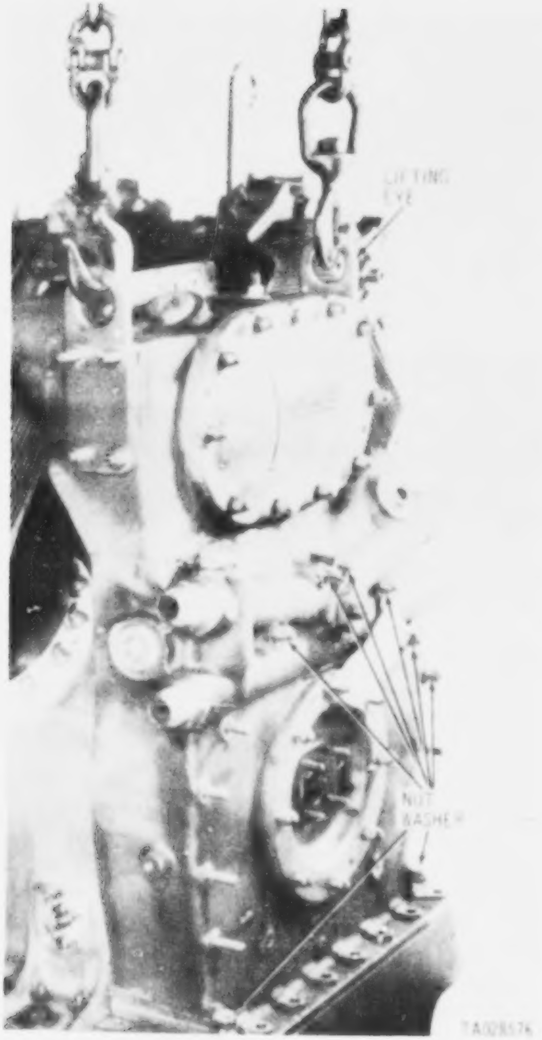


Figure 3-98. Removing or installing crankshaft damper and oil filter housing.

> the piston of the cylinder being removed to top center. Make certain each piston is properly positioned before attempting cylinder removal.

e. Turn engine on stand so right bank cylinder assemblies are in a vertical (upright) position. Rotate crankshaft using splined wrench Part No. 10882747 (fig. 2-42) and observe when connecting rod has raised piston to top center. Remove the remaining two nuts (fig. 3-103) from the right cylinder assembly.

e.1. Turn engine on stand so right bank cylinder assemblies are in a vertical (upright) position. Install power takeoff drive coupling on spur gearshaft and secure with flat washer and self-locking nut (fig. 2-148.2). Install holding bar and puller assembly on coupling (fig. 2-148.2) Rotate crankshaft and observe when connecting rod has raised the piston to top center. Remove the remaining two nuts (fig. 3-103) from the right cylinder assembly.

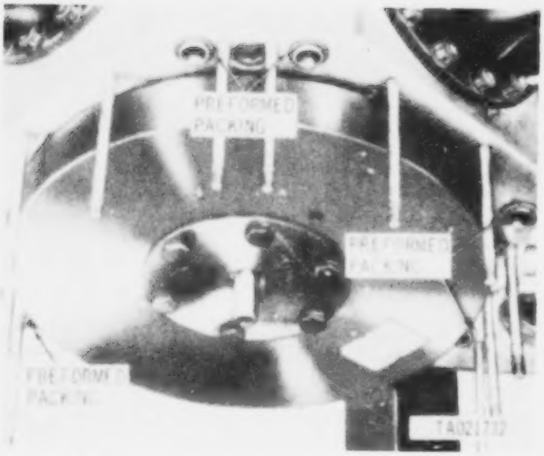


Figure 3-99. Front end of crankcase assembly showing locations of oil transfer tube preformed packings.

NOTE

> Do not remove the nuts holding the left cylinder assemblies (fig. 3-103) to crankcase until left cylinders have been rotated to an upright position for removal.

f. Attach a suitable lifting sling to top of cylinder assembly using two 7/16 x 1 1/4 inch capscrews (fig. 3-104). Carefully lift cylinder assembly until cylinder is just above piston pin bore. Install crankcase protector Part No. 10882790 on cylinder mounting pad studs and secure with two cylinder base nuts and remove cylinder assembly. Replaceable camshaft bearing halves should remain with the cylinder.

NOTE

> Crankcase protector Part No. 10882790 is installed on cylinder pad before removing cylinder assembly from piston. The protector will guard against damage to cylinder pad and mounting studs in the event connecting rods should strike the pad as cylinder is lifted from piston.

NOTE

> When carbon deposits make removal of piston pin difficult, tap end of piston pin with soft faced hammer.

g. Remove piston pin retaining rings and piston pin (fig. 3-105) from piston and remove piston from connecting rod. Reinstall piston pin in piston after it is removed from the connecting rod.

NOTE

> Cylinder No. 6R piston is at top center at

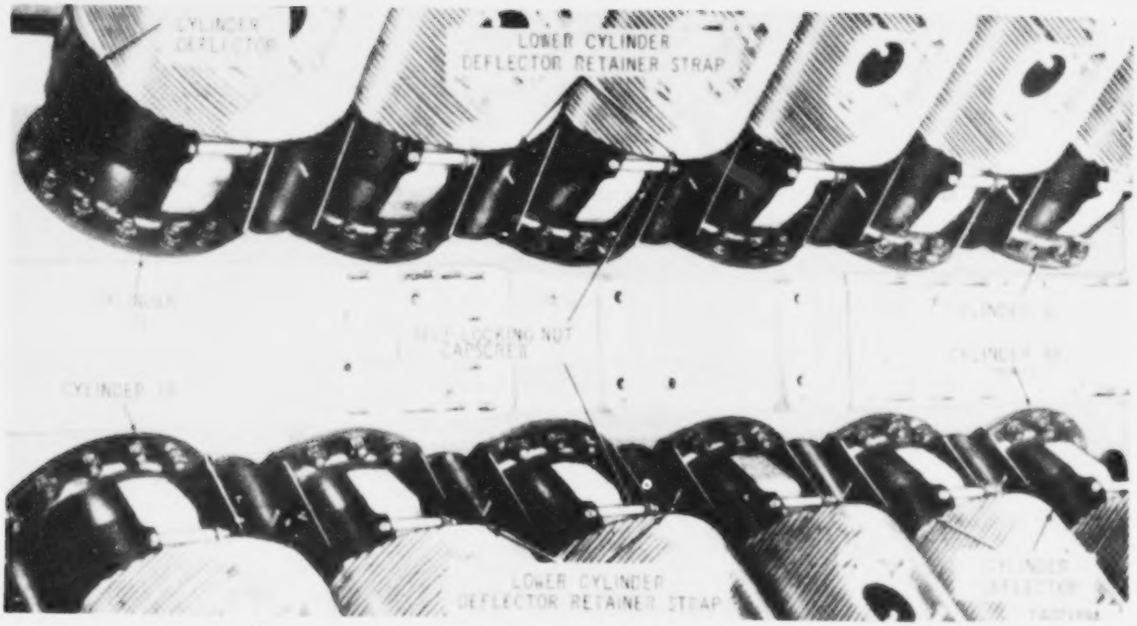

CYLINDER DEFLECTOR
LOWER CYLINDER DEFLECTOR RETAINER STRAP
CYLINDER 1L
SELF-LOCKING NUT CAPSCREW
CYLINDER 6L
CYLINDER 1R
CYLINDER 6R
LOWER CYLINDER DEFLECTOR RETAINER STRAP
CYLINDER DEFLECTOR
TA021816

Figure 3-100. Disconnecting or connecting cylinder deflectors at cylinders.

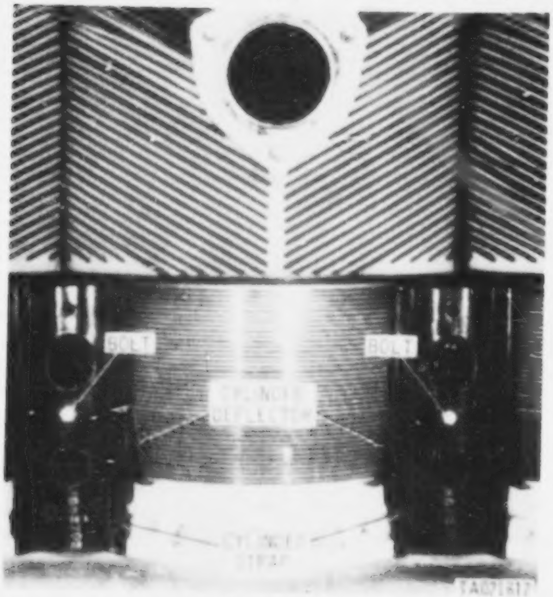

BOLT
BOLT
CYLINDER DEFLECTOR
CYLINDER STRAP
TA021817

Figure 3-101. Removing or installing lower cylinder deflector straps and deflectors right side.

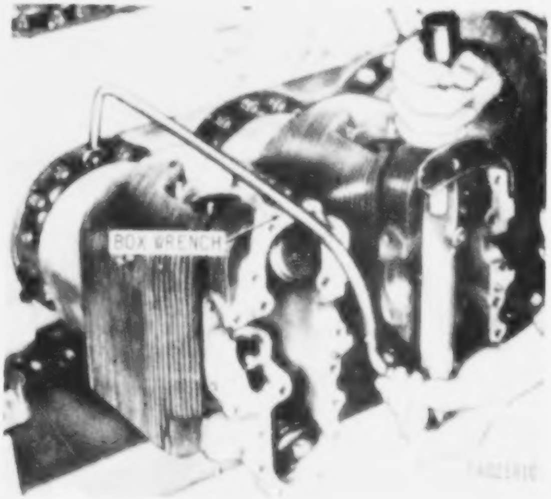

BOX WRENCH
TA021818

Figure 3-102. Checking breaking torque of cylinder base nuts using box wrench.

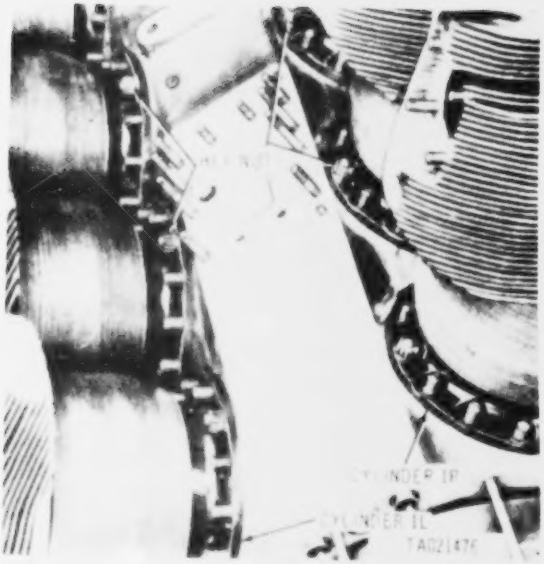


Figure 3-103. Right bank cylinders in vertical position for removing or installing cylinders from crankcase.

the same time as cylinder No. 1R, and can be removed in a similar manner without turning crankshaft. Turn crankshaft until piston in cylinder No. 2R is at top center and remove cylinder. The pistons in cylinder Nos. 2R and 5R will be at top center together, as will pistons for cylinder Nos. 3R and 4R. Position pistons and remove right bank cylinders.

h. The left bank pairs of pistons will be at top center together and be removed in a similar manner. Turn engine on stand to position left bank cylinders in a vertical position, and remove cylinders.

NOTE

Do not remove crankcase protectors Part No. 10882790 (fig. 3-106) until crankshaft and connecting rods have been removed.

3-29. Oil Pump

a. Remove and discard leveling pump transfer tube seal (1, fig. 3-107). Remove two self-locking nuts and capscrews (2) attaching leveling oil pump transfer tube (3) to oil pan pressure compartment baffle (4). Disengage tube assembly from hole in pressure compartment baffle and from opening in oil pump and remove tube assembly from behind pressure compartment baffle. Remove and discard preformed packing from tube assembly.

b. Cut locking wire and remove capscrew (1, fig. 3-108) attaching pressure compartment baffle bracket (2) to oil pump (3) and oil pump to crankcase assembly. Remove two self-locking nuts and machine bolts (4) and remove baffle bracket. Cut locking wire and remove four capscrews and flat washers (5) and loosen the remaining capscrew, located behind the oil pressure relief valve (6) as the oil pump is being removed and remove the oil

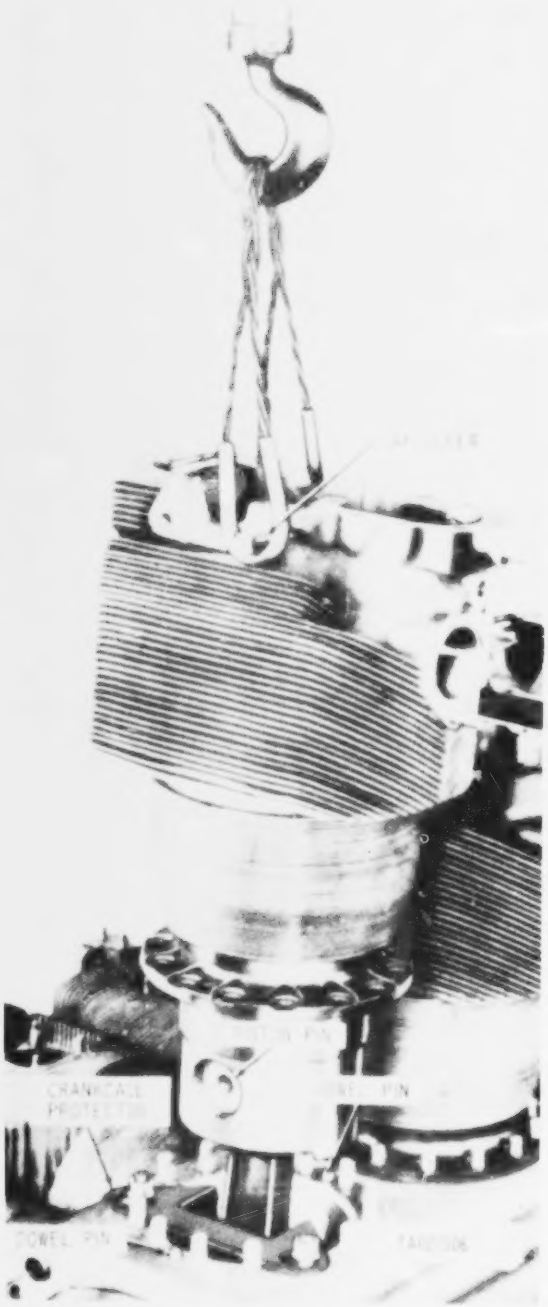


Figure 3-104. Removing cylinder No. 1R.

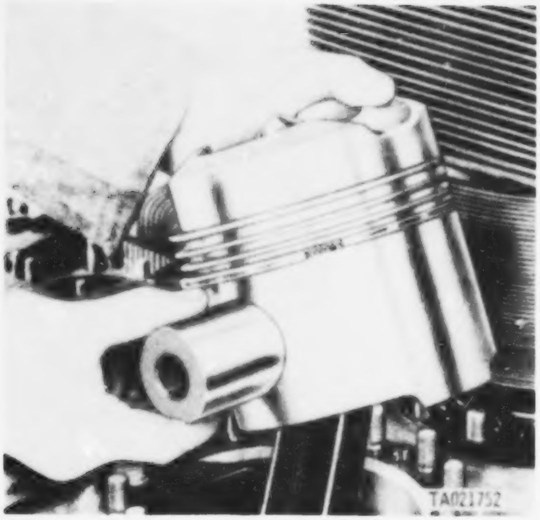


Figure 3-105. Removing piston pin and piston – cylinder No. 1R.

pump. This capscrew cannot be removed until the oil pump is disassembled.

c. Remove six capscrews and lockwashers (fig. 3-109) and remove oil pan pressure compartment baffle.

3-30. Fuel Pump Drive Coupling Adapter and Crankshaft Torsional Vibration Damper.

a. Cut locking wire and remove six bolts (fig. 3-110) attaching fuel pump drive coupling adapter and crankshaft torsional vibration damper to crankshaft and remove adapter and fuel pump drive coupling.

a.1. Cut locking wire and remove six machine bolts (fig. 3-110.1) attaching the power take-off spur gearshaft and crankshaft torsional vibration damper to crankshaft and remove gearshaft.

b. Install three mechanical pullers Part No. 5739997 (fig. 3-111) into puller screw holes provided in crankshaft torsional vibration damper and al-

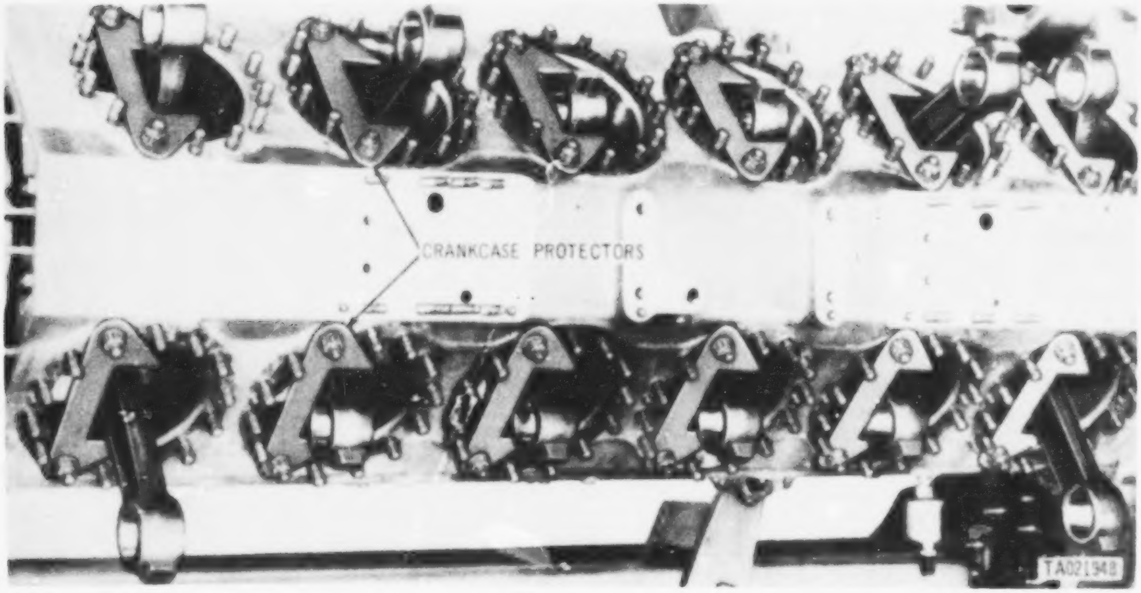
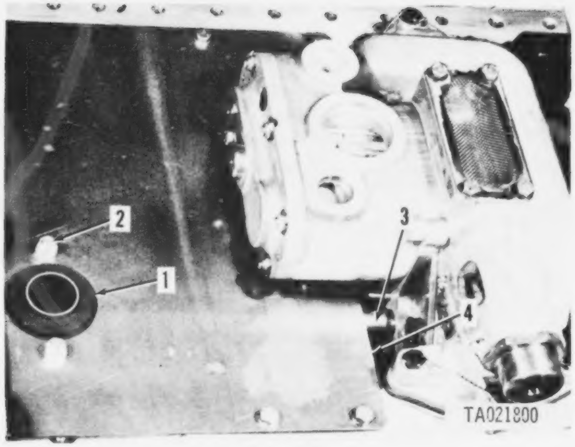
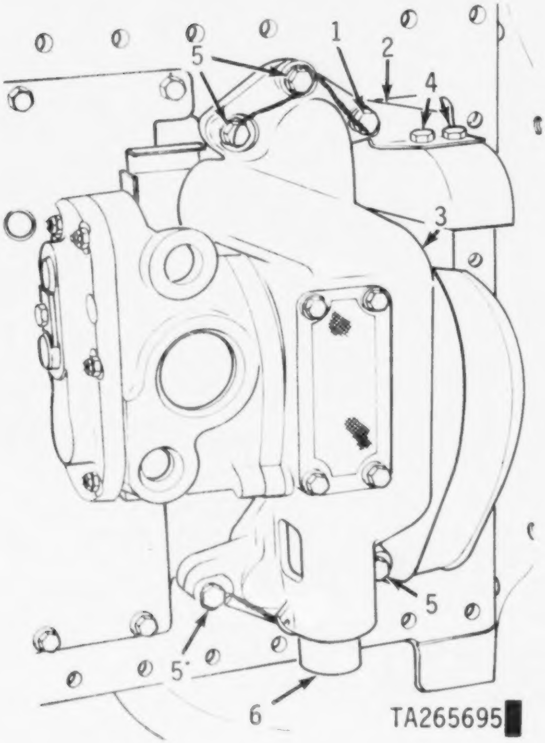


Figure 3-106. Engine with cylinder assemblies and pistons removed showing crankcase protector installed.



1 Tube seal
2 Self-locking nut and capscrew
3 Leveling oil pump transfer tube
4 Oil pan pressure compartment baffle

Figure 3-107. Removing or installing leveling oil pump transfer tube assembly.



1 Capscrew
2 Pressure compartment baffle bracket
3 Oil pump assembly
4 Capscrew
5 Capscrew and flat washer
6 Oil pressure relief valve

Figure 3-108. Removing or installing oil pump.

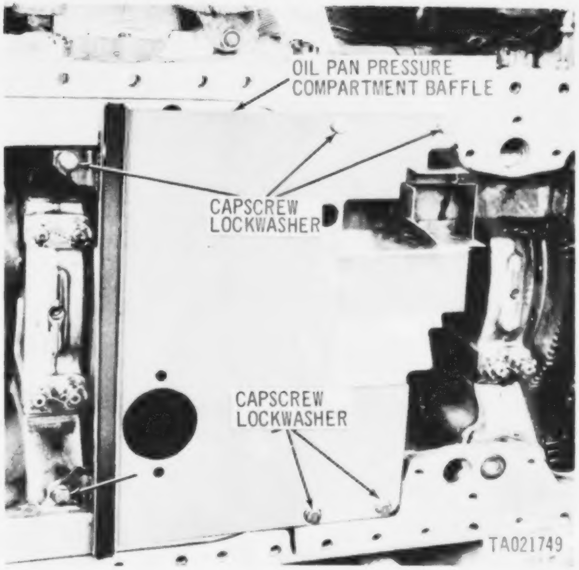


Figure 3-109. Removing or installing oil pan pressure compartment baffle.

ternately tighten puller screws to pull damper from dowel pins in flange of crankshaft, and remove damper from crankshaft.

3-31. Starter Drive Adapter, Starter Driven Gear, and Generator Drive Adapter

a. Remove two starter mounting machine bolts (1, fig. 3-112) and four self-locking nuts and flat washers (2) securing starter drive adapter and remove adapter (3) from crankcase assembly. Remove and discard gasket (4).

b. Remove cotter pin and slotted nut (fig. 3-113) attaching starter driven gear to starter driven gear shaft. Install three 5/16-24 x 3 in bolts (fig. 3-114) for use as puller screws into threaded holes provided in starter driven gear and alternately tighten bolts to pull driven gear from driven gear shaft, and remove starter driven gear and Woodruff key.

Paragraph *c*. deleted.

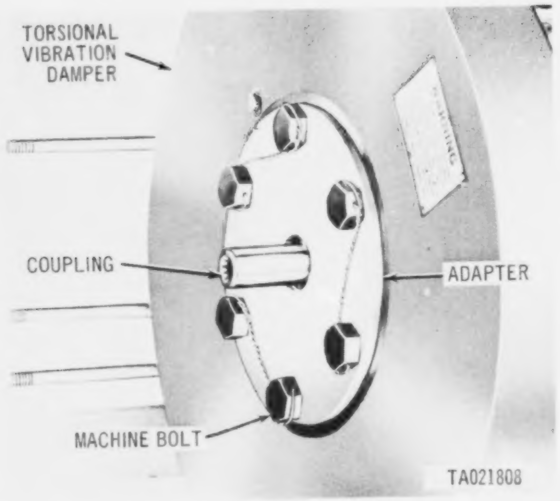

TORSIONAL VIBRATION DAMPER
COUPLING
ADAPTER
MACHINE BOLT
TA021808

Figure 3-110. Removing or installing fuel pump drive coupling adapter and coupling, model AVDS-1790-2C and AVDS-1790-2D engines.

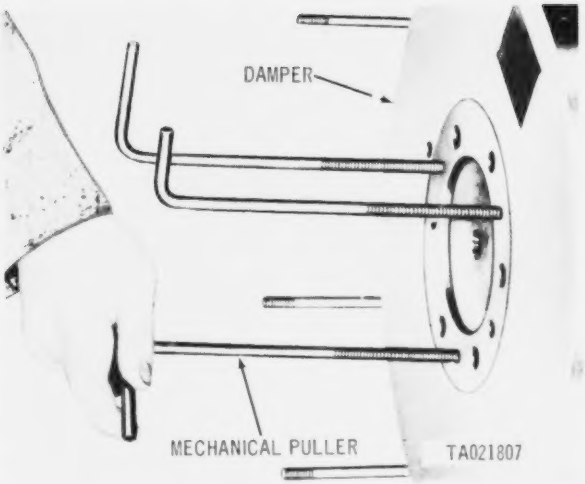

DAMPER
MECHANICAL PULLER
TA021807

Figure 3-111. Removing crankshaft torsional vibration damper using mechanical pullers.

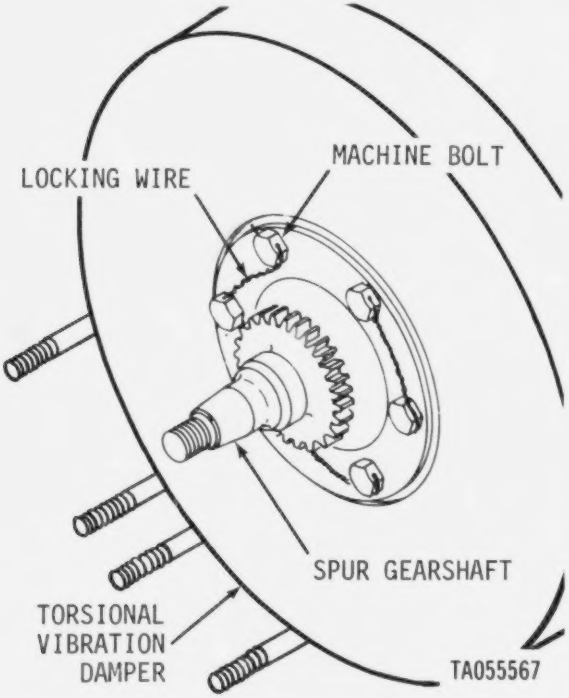
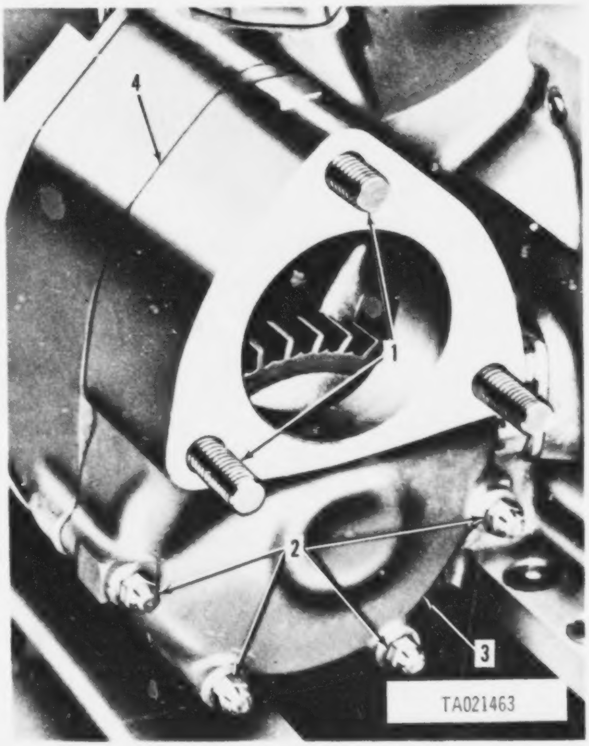

LOCKING WIRE
MACHINE BOLT
SPUR GEARSHAFT
TORSIONAL VIBRATION DAMPER
TA055567

Figure 3-110.1. Removing or installing power take-off spur gearshaft, model AVDS-1790-2DR engine.


4
1
2
3
TA021463

1 Machine bolt
2 Self-locking nut and flat washer
3 Starter drive adapter
4 Gasket

Figure 3-112. Removing or installing starter drive adapter.

d. On model AVDS-1790-2C engine remove self-locking nut and flat washer located at the nine o'clock position and five bolts and lockwashers (fig. 3-115) attaching the generator drive adapter to the crankcase assembly. Remove the generator drive

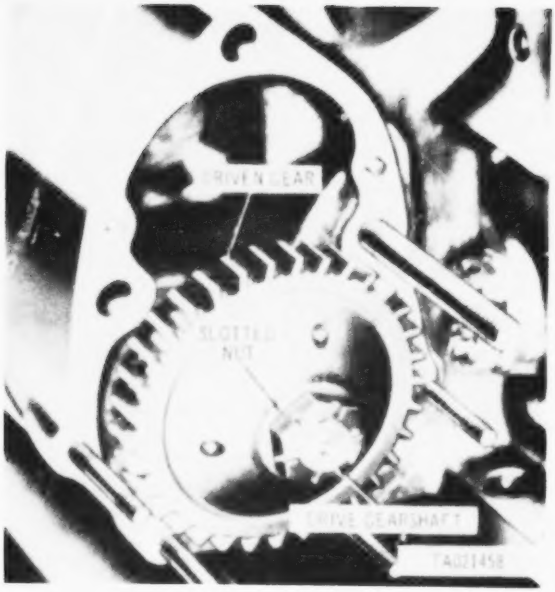

DRIVEN GEAR
SLOTTED NUT
DRIVE GEARSHAFT
TA021458

Figure 3-113. Removing or installing starter driven gear attaching parts.

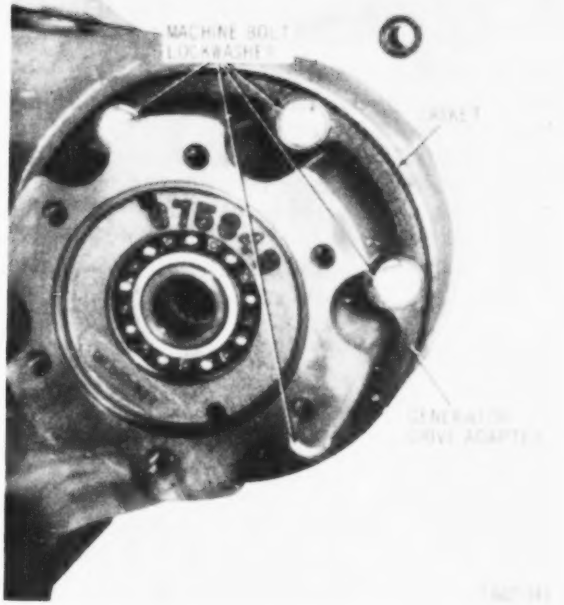

MACHINE BOLT
LOCKWASHER
GASKET
GENERATOR DRIVE ADAPTER

Figure 3-115. Removing or installing generator drive adapter and associated parts, model AVDS-1790-2C engine.

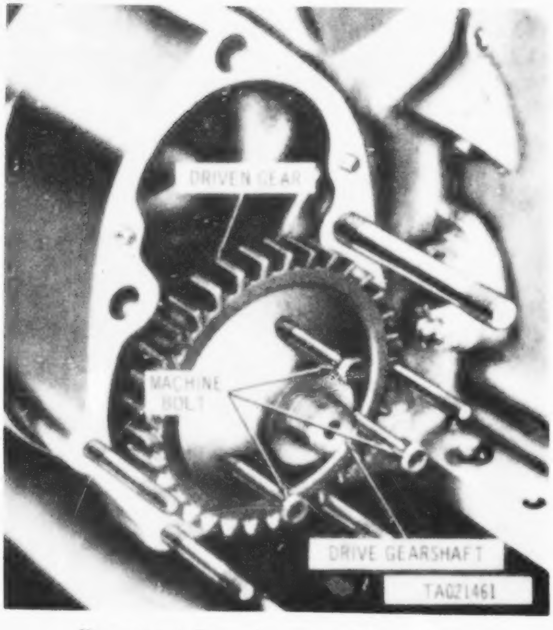

DRIVEN GEAR
MACHINE BOLT
DRIVE GEARSHAFT
TA021461

Figure 3-114. Removing starter driven gear.

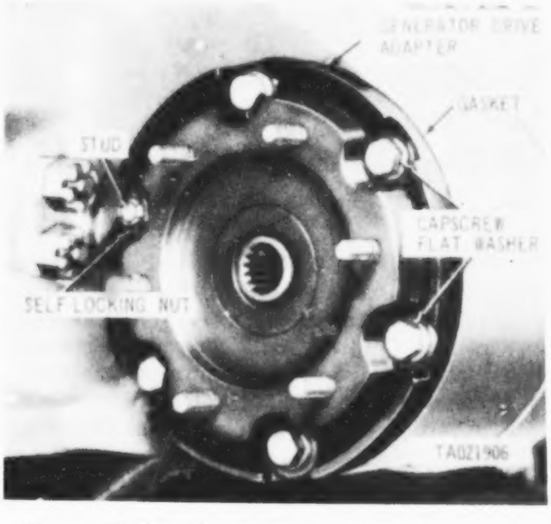

GENERATOR DRIVE ADAPTER
GASKET
STUD
CAPSCREW
FLAT WASHER
SELF LOCKING NUT
TA021906

Figure 3-116. Removing or installing generator drive adapter model AVDS-1790-2D and AVDS-1790-2DR engines.

adapter with drive gear shaft and bearings as an assembly. Remove and discard gasket.

e. On Model AVDS-1790-2D and AVDS-1790-2DR engines, remove self-locking nut and flat washer (fig. 3-116). Remove five capscrews and flat washers and remove generator drive adapter with drive gearshaft and bearing as a unit. Remove and discard gasket.

3-32. Flywheel, Flywheel Adapter, Transmission Adapter, Transmission Housing Adapter, Crankshaft Oil Seal Housing, and Accessory Drive Gear

a. Straighten tabs of lock plates (fig. 3-117) and remove nine bolts and three lock plates attaching transmision drive spur gear and flywheel to crankshaft. Install three 9/16 x 1-3/4 in. transmission spur gear mounting bolts into puller screw holes and remove transmission drive spur gear from crankshaft dowel pins by alternately tightening the three bolts. Remove the puller screws from the spur gear.

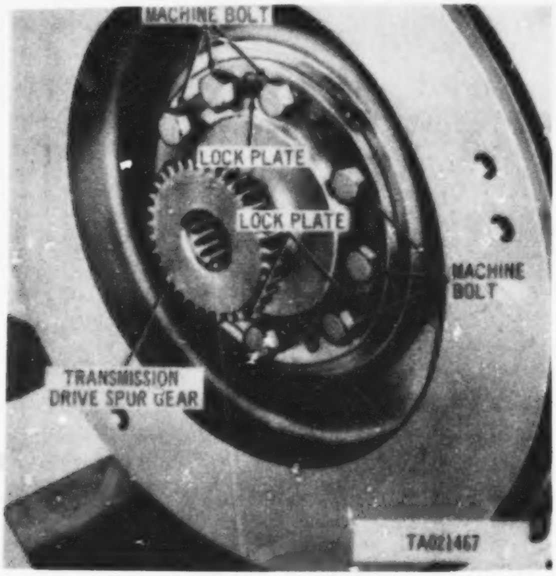

MACHINE BOLT
LOCK PLATE
LOCK PLATE
MACHINE BOLT
TRANSMISSION DRIVE SPUR GEAR
TA021467

Figure 3-117. Removing or installing transmission drive spur gear, model AVDS-1790-2C and AVDS-1790-2D engines.

b. Position flywheel to locate lifting eye bolt hole at top center. Install three 9/16 x 1-3/4 in. bolts (fig. 3-118) from transmission drive spur gear and flywheel into flywheel puller holes. Alternately tighten bolts until flywheel is far enough from crankshaft dowel pins to permit installation of lifting eye bolt. Install lifting eye bolt Part No. MS51937-7.

CAUTION

Use care in removing the flywheel from the dowel pins so as not to bind the flywheel on the pins.

c. Remove flywheel from the two dowel pins in flange of crankshaft. Remove three puller bolts from flywheel.

c.1. Position flywheel to locate lifting eye bolt hole at top center. Install lifting eye bolt, Part No. MS51937-7 (fig. 3-118.1). Cut locking wire and remove eight machine bolts. Remove flywheel and remove lifting eye bolt.

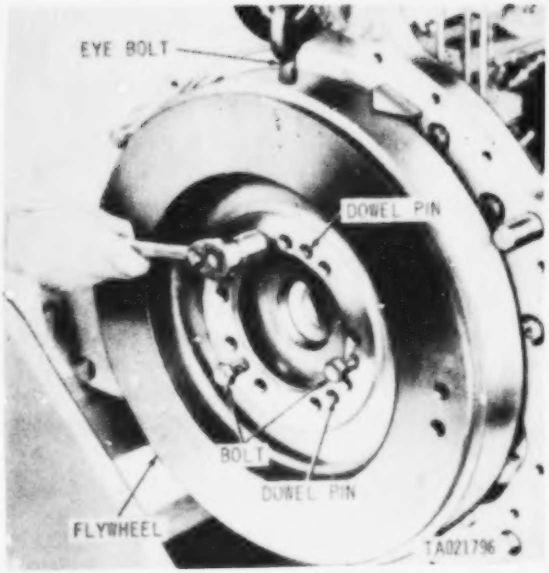

EYE BOLT
DOWEL PIN
BOLT
DOWEL PIN
FLYWHEEL
TA021796

Figure 3-118. Removing flywheel, model AVDS-1790-2C and AVDS-1790-2D engines.

c.2. Straighten tabs on three lock plates (fig. 3-118.2). Remove nine machine bolts and lock plates securing flywheel adapter to cranksahft. Discard lock plates.

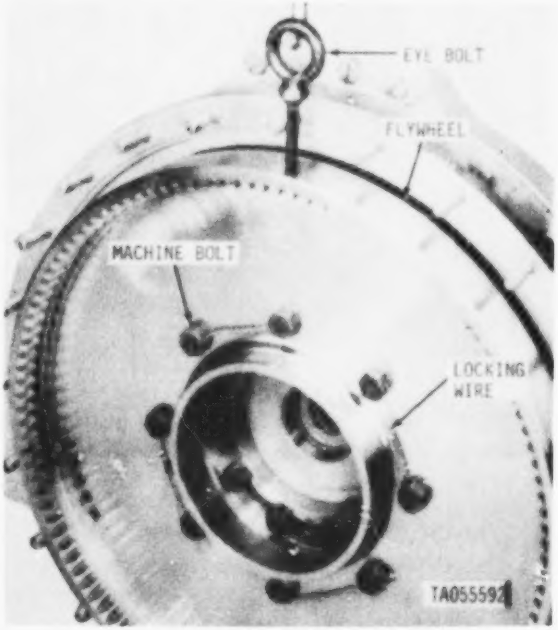

EYE BOLT
FLYWHEEL
MACHINE BOLT
LOCKING WIRE
TA055592

Figure 3-118.1. Removing or installing flywheel, model AVDS-1790-2DR engine.

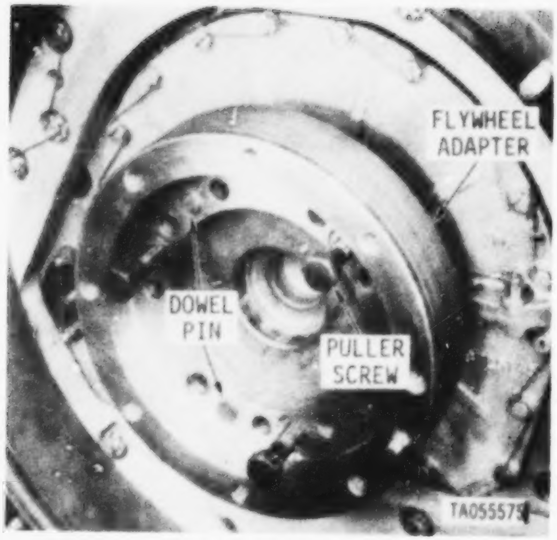

FLYWHEEL ADAPTER
DOWEL PIN
PULLER SCREW
TA055575

Figure 3-118.2. Removing flywheel adapter machine bolts and lock plates, model ADVS-1790-2DR engine.

c.3. Install three 9/16 x 1-3/4 in. bolts in puller screw holes (fig. 3-118.3). Alternately tighten bolts and pull flywheel adapter from crankshaft dowel pins. Remove bolts from dapter.

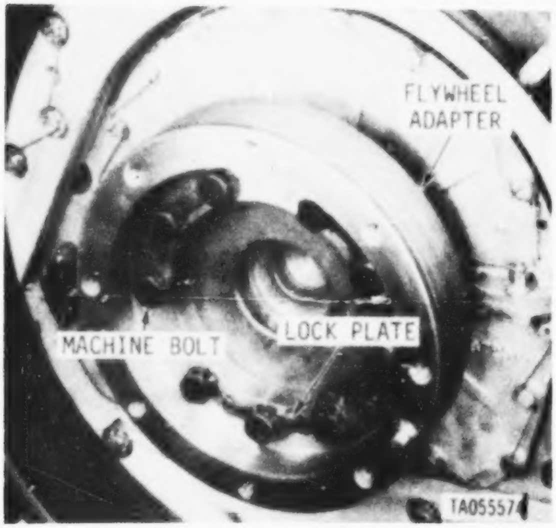

FLYWHEEL ADAPTER
MACHINE BOLT
LOCK PLATE
TA055574

Figure 3-118.3. Removing flywheel adapter, model AVDS-1790-2DR engine.

c.4. Remove 17 capscrews and lockwashers attaching the transmission housing adapter to the transmission adapter (fig. 3-118.4). Remove two capscrews and self-locking nuts and remove the adapter.

d. Cut locking wire and remove two slotted nuts (fig. 3-119) at top of adapter, and fifteen slotted nuts securing transmission adapter to the crankcase. Remove four self-locking nuts. Attach a suitable chain hoist in transmission adapter lifting eye (fig. 3-120) and separate adapter from studs, dowel pins and crankcase assembly. Remove adapter and remove and discard gasket.

NOTE

Model AVDS-1790-2DR engine transmission adapter is not equipped with the two large dowel pins.

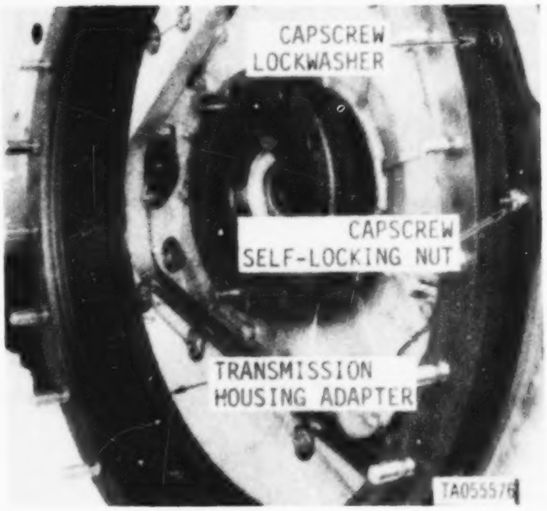

CAPSCREW LOCKWASHER
CAPSCREW SELF-LOCKING NUT
TRANSMISSION HOUSING ADAPTER
TA055576

Figure 3-118.4. Removing or installing transmission housing adapter, model AVDS-1790-2DR engine.

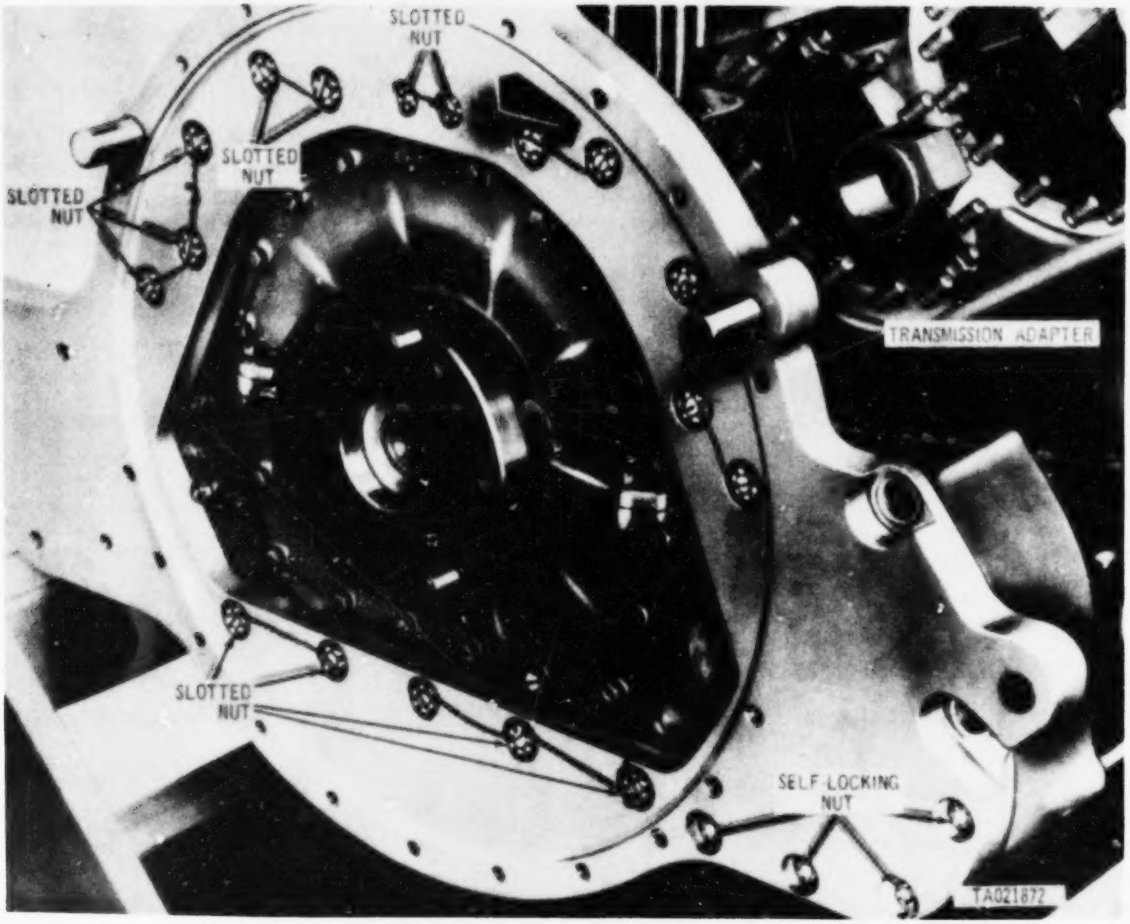

SLOTTED NUT
SLOTTED NUT
SLOTTED NUT
TRANSMISSION ADAPTER
SLOTTED NUT
SELF-LOCKING NUT
TA021872

Figure 3-119. Removing or installing transmission adapter attaching parts.

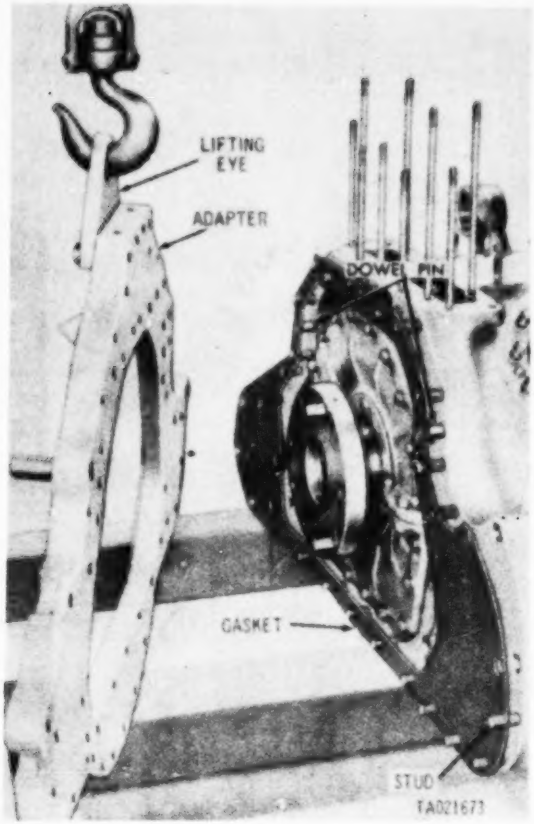

LIFTING EYE
ADAPTER
DOWEL PIN
GASKET
STUD
TA021673

Figure 3-120. Removing or installing transmission adapter.

e. Cut locking wire and remove three bolts (fig. 3-121) attaching oil seal retainer to oil seal cap, and three bolts attaching oil seal retainer to oil seal housing and remove the two retainers.

f. Cut locking wire and remove four slotted nuts and flat washers (fig. 3-122) attaching oil seal cap to oil seal housing, and twenty machine bolts and flat washers attaching oil seal cap and housing to crankcase assembly.

NOTE

Free the oil seal cap and housing from dowel pins by tapping edges of the oil seal cap and housing with a soft faced hammer, or using two mechanical puller Part No. 5739997.

g. Separate and remove oil seal cap and housing (fig. 3-123) and remove and discard gasket.

NOTE

The oil seal housing is machined with the crankcase and is a mating part. Always keep oil seal housing with the crankcase.

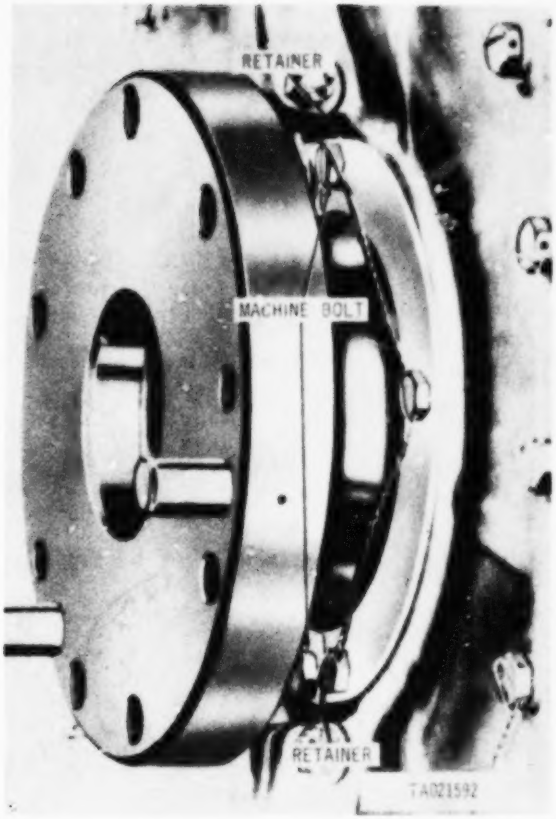

RETAINER
MACHINE BOLT
RETAINER
TA021592

Figure 3-121. Removing or installing crankshaft oil seal retainers.

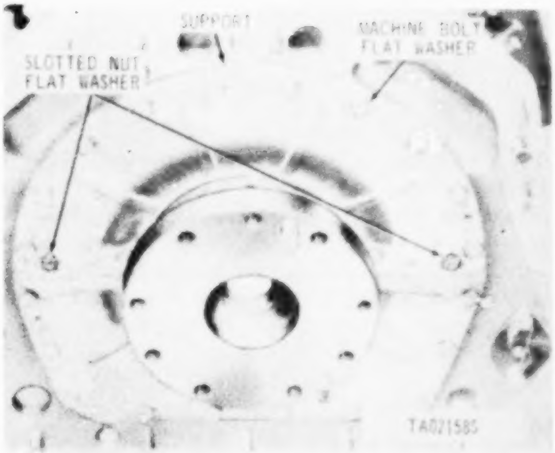

SUPPORT
MACHINE BOLT
FLAT WASHER
SLOTTED NUT
FLAT WASHER
TA021585

Figure 3-122. Removing or installing crankshaft oil seal cap and housing mounting bolts.

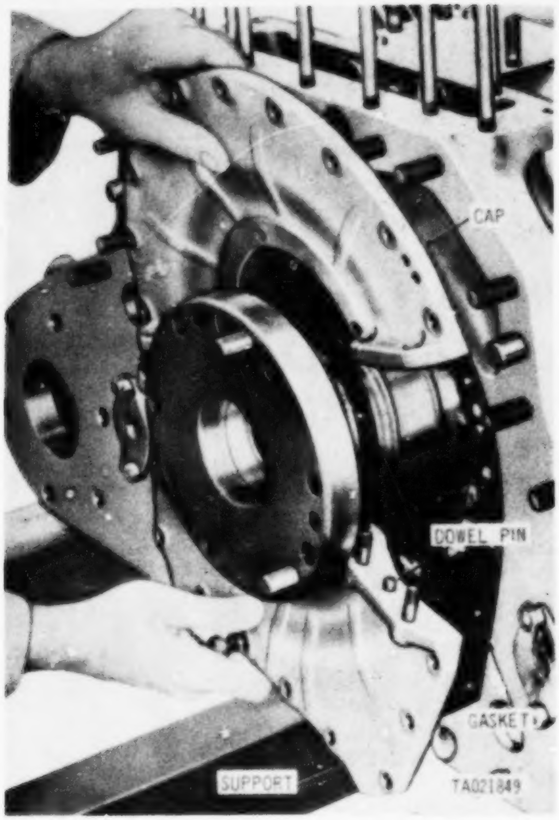

CAP
DOWEL PIN
GASKET
SUPPORT
TA021849

Figure 3-123. Removing or installing oil seal cap and housing.

h. Remove four capscrews and flat washers (fig. 3-125) attaching oil seal housing support to crankcase assembly. Remove support from dowel pins in crankcase and remove and discard candlewick packing.

NOTE

> It may be necessary to loosen No. 7 main bearing engine crankcase rod nuts (fig. 3-128) before removing support.

i. Cut locking wire and remove twelve bolts (fig. 3-125) attaching accessory drive gear to flange on crankshaft. Install three 7/16 x 1-1/8 in. accessory drive gear mounting bolts (fig. 3-126) in tapped holes provided in accessory drive gear and alternately tighten bolts and pull accessory drive gear from flange on crankshaft. Remove puller bolts from gear.

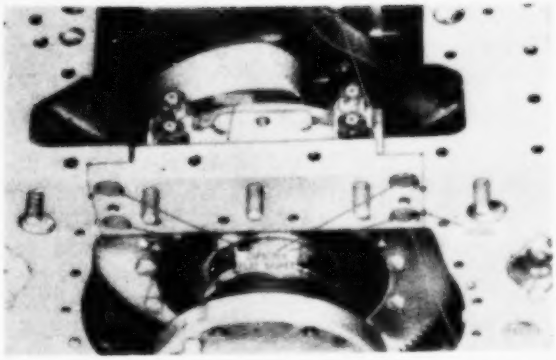


Figure 3-124. Removing or installing oil seal housing support.

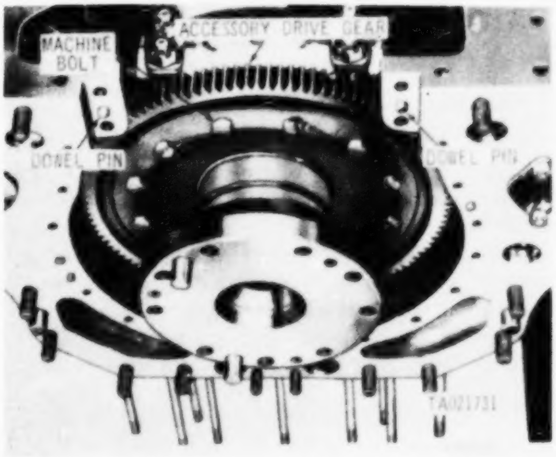

MACHINE BOLT
ACCESSORY DRIVE GEAR
DOWEL PIN
DOWEL PIN
TA021731

Figure 3-125. Removing or installing accessory drive gear mounting bolts.

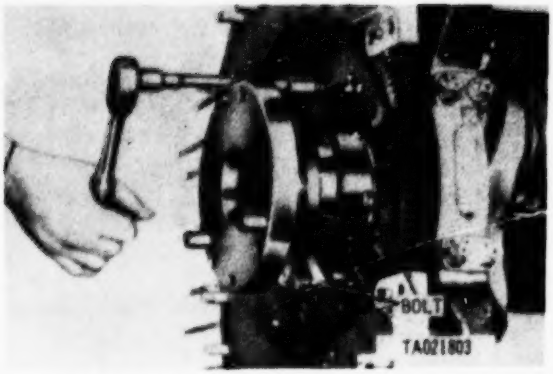


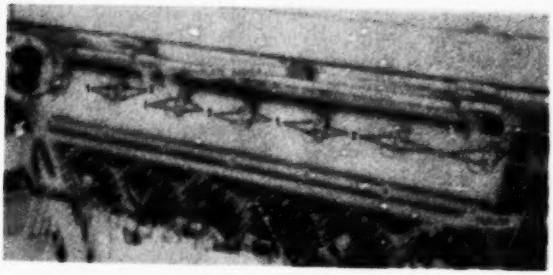
Figure 3-126. Removing accessory drive gear.

3-33. Crankshaft and Connecting Rod Assembly

NOTE

To avoid interference with the starter driven gearshaft, it is necessary to remove lower No. 7 main bearing engine crankcase rod from right side of crankcase.

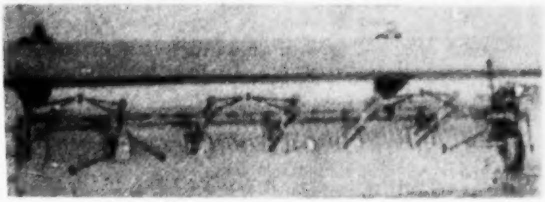
a. Remove twelve cotter pins, slotted nuts (1, fig. 3-127) and six plate washers from twelve engine crankcase rods (2), hold rod nuts on opposite end as necessary to keep rods from turning while removing nuts. Remove cotter pins and slotted nut (3) from upper engine crankcase rod and remove cotter pin and slotted nut from opposite side (left) of lower rod (4). Using a suitable brass rod push the 13 engine crankcase rods through crankcase assembly.



1 Slotted nut and cotter pin
2 Engine crankcase rod
3 Slotted nut
4 Lower ending crankcase rod

Figure 3-127. Removing or installing engine crankcase rod attaching parts — right front view.

b. Remove cotter pin and slotted nut (1, fig. 3-128) and plate washer and remove upper engine crankcase rod at No. 7 main bearing, from left side of crankcase assembly. Remove lower No. 7 main bearing engine crankcase rod (2) slotted nut and plate washer from opposite side of crankcase and remove rod. Remove twelve cotter pins, slotted nuts (3) and six plate washers (4) from crankcase. Separate parts.



1 Slotted nut
2 Engine crankcase rod
3 Slotted nut
4 Plate washer
5 Starter driven gearshaft
6 Engine crankcase rod

Figure 3-128. Removing or installing engine crankcase rods and attaching parts — left side view.

NOTE

The main bearing caps are marked 1 through 7 (front to rear) to identify their locations. Identifying numbers also appear on bearing web in crankcase assembly. The caps are not interchangeable with each other and must be returned to their original positions during installation.

NOTE

Do not use a scriber or other sharp instrument for marking bearing halves. It is recommended that a grease pencil be used for marking bearing halves.

c. Cut locking wire and remove 24 slotted nuts (fig. 3-129) and 12 plate washers attaching main bearing caps, numbers 1, 2, 3, 5, 6, and 7 to crankcase assembly. Cut locking wire and remove four slotted nuts and two plate washers attaching main thrust bearing cap (No. 4 or center) to crankcase assembly.

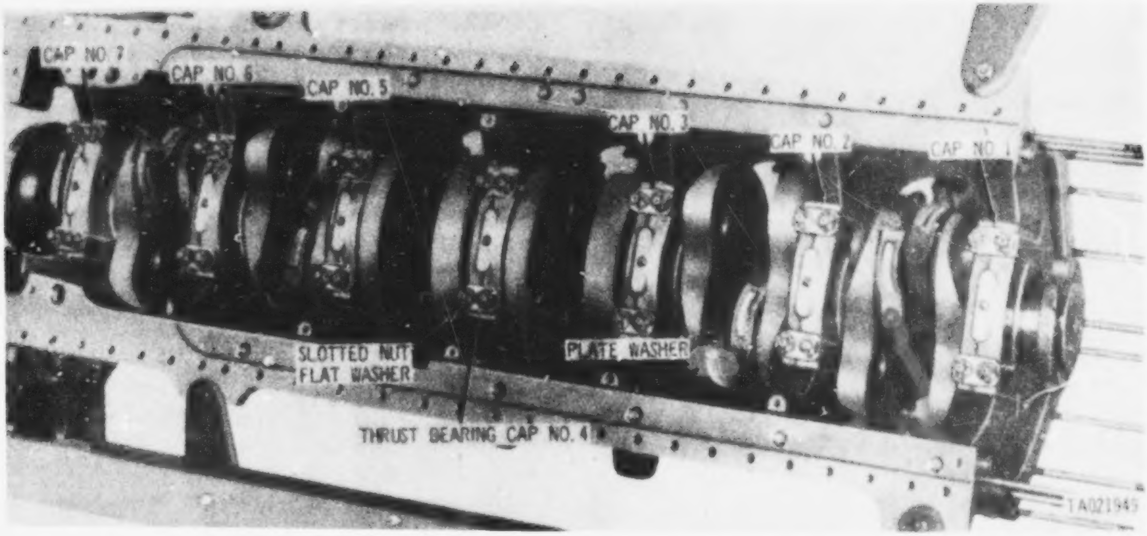

CAP NO. 7
CAP NO. 6
CAP NO. 5
CAP NO. 3
CAP NO. 2
CAP NO. 1
SLOTTED NUT
FLAT WASHER
PLATE WASHER
THRUST BEARING CAP NO. 4
TA021949

Figure 3-129. Removing or installing main bearing attaching parts.

NOTE

Use caution when removing main bearing cap so that lower main sleeve bearing half does not drop out accidentally. Sleeve bearing halves can be easily damaged.

d. Install crankcase spreading tool Part No. 8708361 (fig. 3-130) in crankcase assembly midway between two main bearing caps. Tighten spreading tool just enough to release pressure of crankcase from ends of main bearing caps. Install mechanical puller Part No. 8708712 in mechanical adapter Part No. 8375091. Install puller adapter into threaded hole provided in No. 1 main bearing cap. Gently tap the main bearing cap free of the crankcase using the slide hammer on puller. Remove main bearing cap and lower main sleeve bearing half and separate the bearing half from the cap. Mark sleeve bearing half with its respective location, using a grease pencil, for identification; e.g., "1 cap," "2 cap," etc.

e. Remove remaining bearing caps (Nos. 2 through 7) and the lower sleeve bearing halves in similar manner using puller Part No. 8708712 and positioning the spreading tool, Part No. 8708361, between bearing caps as necessary. Remove sleeve bearings from bearing caps.

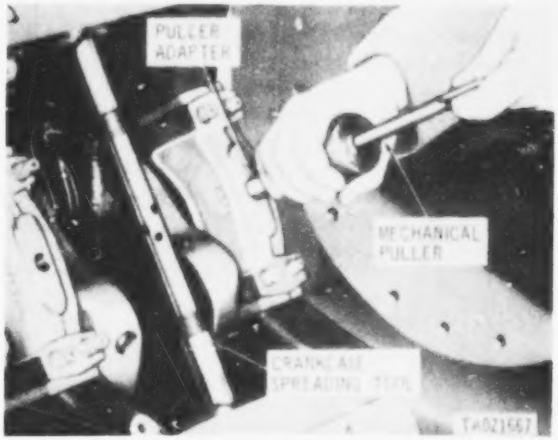

PULLER ADAPTER
MECHANICAL PULLER
CRANKCASE SPREADING TOOL
TA021567

Figure 3-130. Removing main bearing cap using crankcase spreading tool, mechanical adapter and mechanical puller.

NOTE

The crankshaft counterweights for connecting rod bearing journals 1R and 1L and 6R and 6L must be in the position shown in fig. 3-131. The crankshaft will then clear the sides of the crankcase when it is removed.

f. Rotate crankshaft as necessary to obtain proper position of crankshaft counterweights for removal.

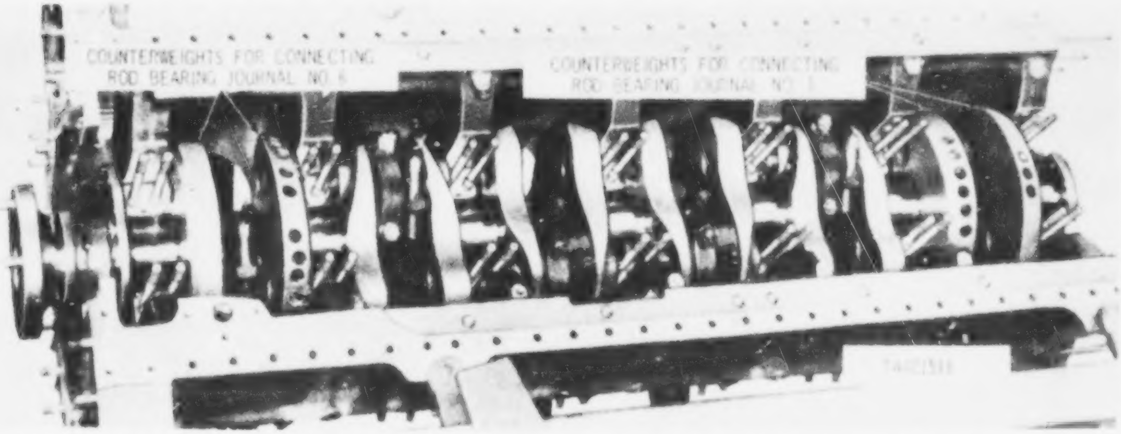

COUNTERWEIGHTS FOR CONNECTING ROD BEARING JOURNAL NO. 6
COUNTERWEIGHTS FOR CONNECTING ROD BEARING JOURNAL NO. 1

Figure 3-131. Crankshaft with main bearing caps removed showing correct position of crankshaft counterweights before removal or after installation of crankshaft.

NOTE

The crankshaft and connecting rod sling Part No. 10882958 consists of a cable and two adapters. The adapter with the dowel pin hole attaches to the crankshaft flywheel flange. The other adapter attaches to the torsional vibration damper mounting flange.

g. Install the sling adapter (fig. 3-132) on flywheel flange dowel pin and secure the adapter to flange with two flywheel mounting bolts.

h. Install the sling adapter (fig. 3-133) to torsional vibration damper flange crankshaft and secure with two vibration damper mounting bolts.

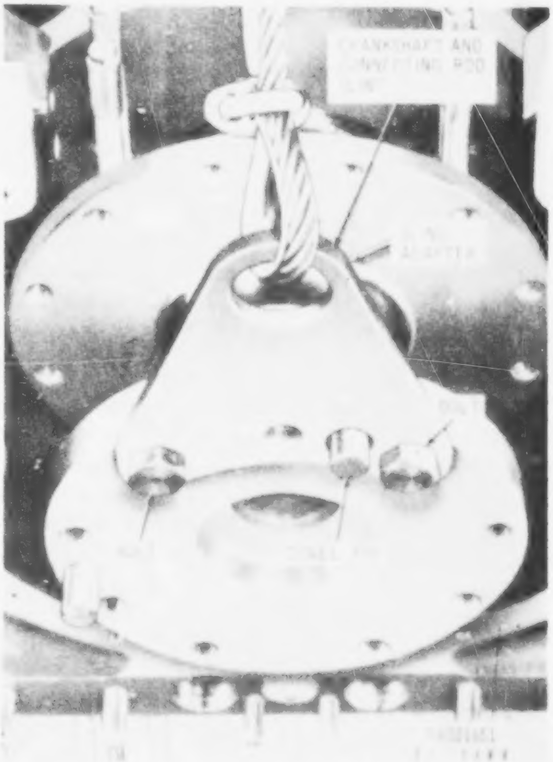

CRANKSHAFT AND CONNECTING ROD SLING
SLING ADAPTER
BOLT
BOLT
DOWEL PIN

Figure 3-132. Installing or removing crankshaft and connecting rod sling at crankshaft flywheel flange.

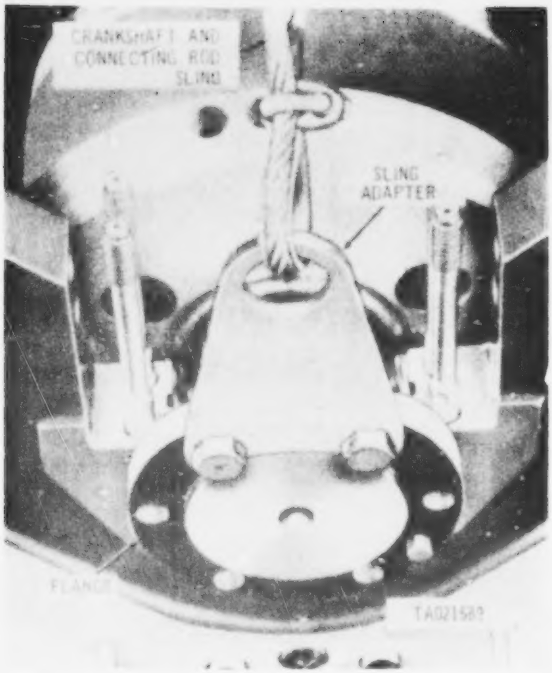

CRANKSHAFT AND CONNECTING ROD SLING
SLING ADAPTER
FLANGE
TA021582

Figure 3-133. Installing or removing crankshaft and connecting rod sling at crankshaft torsional vibration damper flange.

NOTE

Exercise care when removing or installing crankshaft assembly to prevent damage to the main bearing cap studs and crankshaft journals.

i. Remove crankshaft with connecting rod assemblies installed as shown in fig. 3-134 using a suitable hoist. Place crankshaft assembly on suitable "**V**" blocks with crankshaft resting on bearing journals. Remove sling from crankshaft.

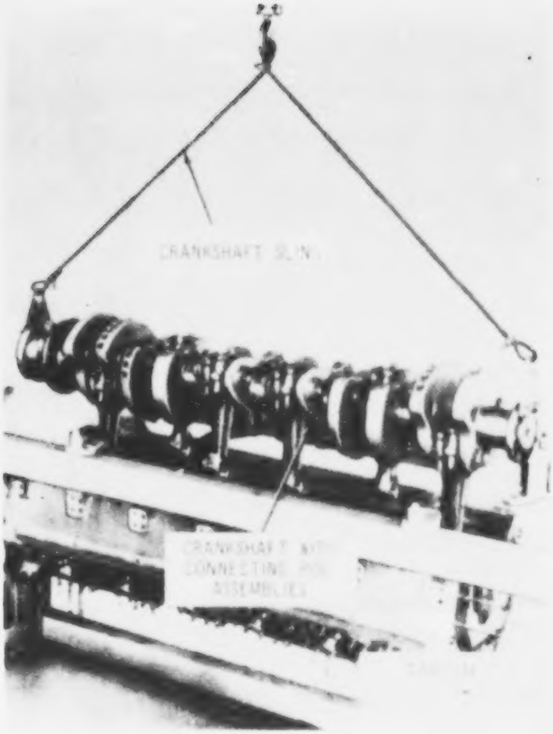

CRANKSHAFT SLING
CRANKSHAFT WITH CONNECTING ROD ASSEMBLIES

Figure 3-134. Removing or installing crankshaft and connecting rod assemblies using crankshaft and connecting rod sling.

j. Remove six upper main sleeve bearing halves (fig. 3-135) from bearing bores in crankcase assembly. Mark respective locations of bearings on the back of bearing half using a grease pencil; e.g., "1-case", "2-case", etc. Remove upper main thrust sleeve bearing half and mark as "4-case" for identification.

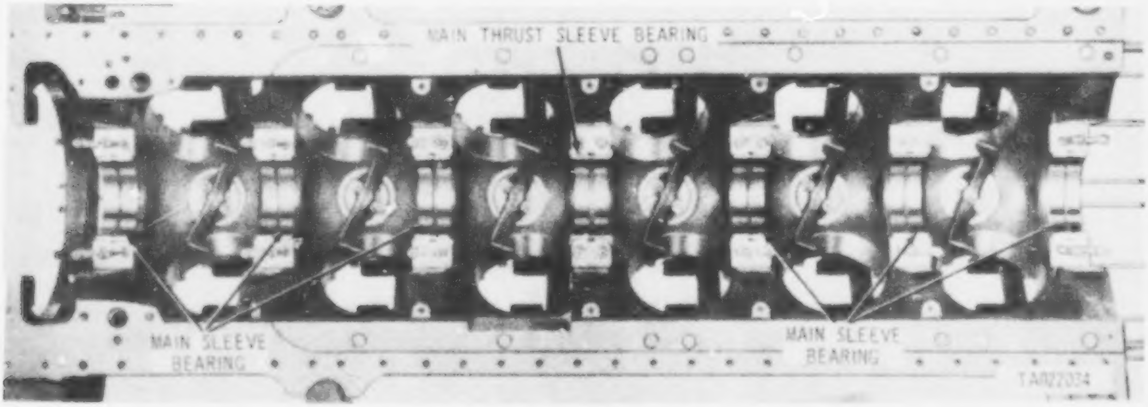

MAIN THRUST SLEEVE BEARING
MAIN SLEEVE BEARING
MAIN SLEEVE BEARING
TA022034

Figure 3-135. Removing or installing upper main sleeve bearing halves.

3-34. Piston Oiler Nozzles, Generator, and Starter Idler Gears

a. Cut locking wire, remove 12 slotted nuts (fig. 3-136) and remove six piston oiler nozzle assemblies. Remove 12 crankcase protectors Part No. 10882790.

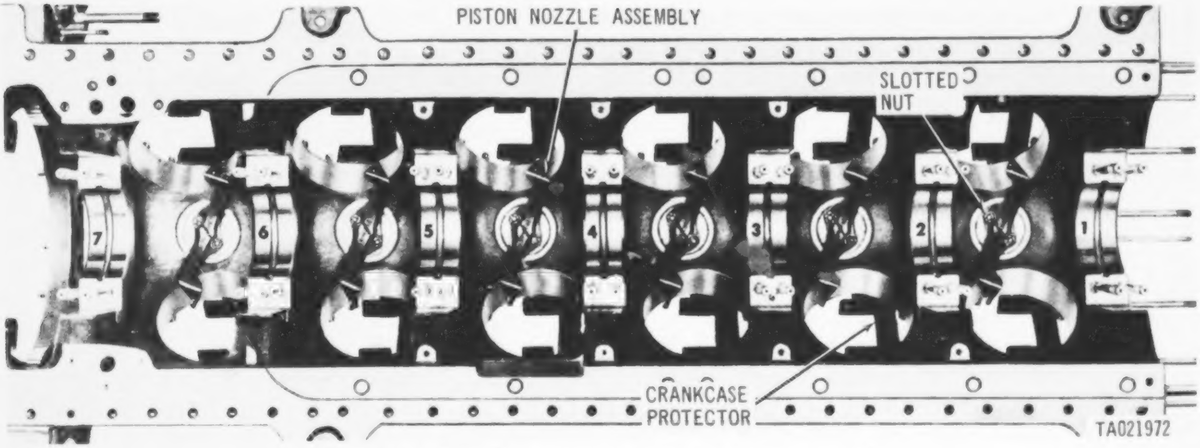

PISTON NOZZLE ASSEMBLY
SLOTTED NUT
7
6
5
4
3
2
1
CRANKCASE PROTECTOR
TA021972

Figure 3-136. Removing or installing piston oiler nozzle assemblies.

b. Cut locking wires and remove two slotted nuts (fig. 3-137) attaching starter idler gear shaft to crankcase. Remove two slotted nuts attaching generator idler gearshaft to crankcase.

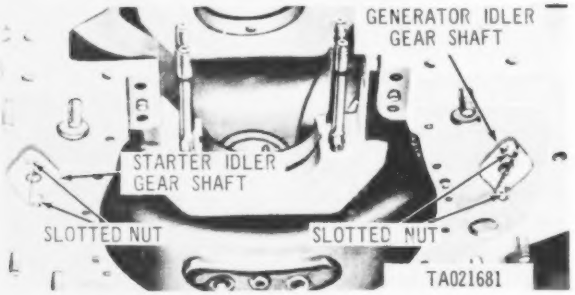

GENERATOR IDLER GEAR SHAFT
STARTER IDLER GEAR SHAFT
SLOTTED NUT
SLOTTED NUT
TA021681

Figure 3-137. Removing or installing starter and generator idler gearshaft flange nuts.

c. Install mechanical adapter Part No. 8375091 (fig. 3-138) into tapped hole provided in end of starter idler gearshaft and install mechanical puller Part No. 8708712 into adapter. Slide hammer on puller against handle to pull starter idler gearshaft from crankcase assembly. Support starter idler gear with wooden block while removing gearshaft and then remove idler gear. Remove and discard preformed packing.

NOTE

Remove generator idler gearshaft and idler gear in the same manner as instructed for starter idler gearshaft and idler gear.

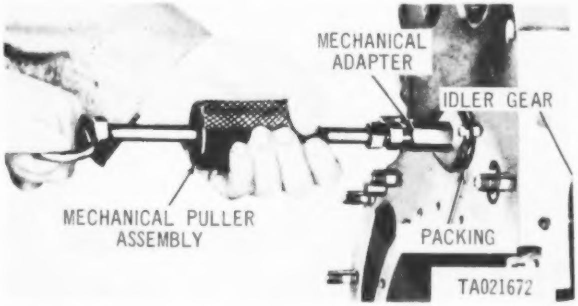

MECHANICAL ADAPTER
IDLER GEAR
MECHANICAL PULLER ASSEMBLY
PACKING
TA021672

Figure 3-138. Removing starter and/or generator idler gearshaft.

d. Cut locking wire and remove six slotted nuts (fig. 3-139) attaching starter driven gearshaft bearing cage to crankcase assembly. Install two 5/16-24 jack screws in holes provided in cage. Alternately tighten jack screws until cage separates from crankcase.

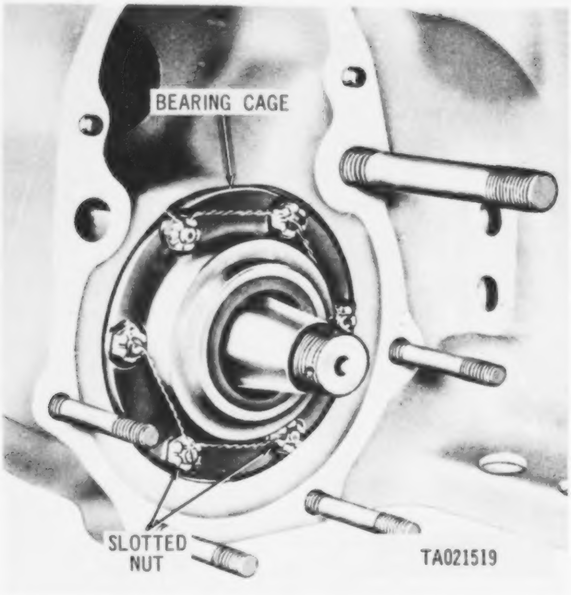


Figure 3-139. Removing or installing starter driven gearshaft bearing cage attaching parts.

e. Remove starter driven gearshaft bearing cage (fig. 3-140) from crankcase assembly and remove and discard preformed packing. Remove jack screws from bearing cage.

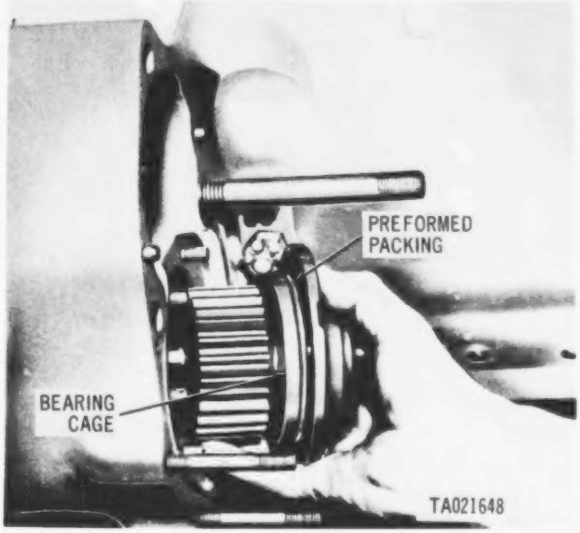


Figure 3-140. Removing or installing starter gearshaft bearing cage.

Section III. GENERAL REPAIR PROCEDURES

3-35. General

a. The procedures for cleaning, inspection, repair and assembly of the various parts and components which make up the engine sub-assemblies will be the same for a great percentage of parts and components. To avoid repetition, the general procedures are detailed in paragraphs 3-36 through 3-41 and will be referenced throughout this chapter.

b. Any cleaning, inspection, repair, and assembly procedures which are peculiar to a specific part or component will be covered in the section or paragraph relating to that item.

3-36. Cleaning Instructions

a. General. The importance of cleaning must be thoroughly understood by maintenance personnel. Great care and conscientious effort are required in all cleaning operations. The presence of dirt or foreign material is a constant threat to satisfactory engine operation and maintenance. A dirty operation can result in cylinder scuffing or scratching, high oil consumption, bearing destruction, and a variety of component failures directly attributed to the entrance of dirt. Maintain rigid cleaning standards during all phases of the cleaning operation. The following general instructions apply to all cleaning operations.

(1) Clean all parts before inspection, after repair, and before assembly.

(2) Hands should be kept free of any accumulation of grease, which can collect dust and grit.

(3) After cleaning, all parts should be covered or wrapped to protect them from dirt and dust accumulation.

b. Castings.

(1) Remove sludge and gum deposits using a stiff brush.

(2) Clean all surfaces with dry-cleaning solvent (P-D-680, type II). Repeat operation if surface is not free of scale or adhering material which might be dislodged later.

(3) Blow out all tapped holes with compressed air.

(4) After cleaning, dry casting with compressed air.

WARNING

Particles blown by compressed air are hazardous. Make certain air stream is directed away from user and that other persons are not exposed. Protect eyes and face with appropriate shields.

c. Oil Passages. Particular attention must be given to all oil passages in machined parts. All oil passages must be free of obstructions.

(1) Clean passages with wire or probes to break

up all sludge or gum deposits.

(2) Wash passages by flushing with dry-cleaning solvent (P-D-680, Type II). Be sure passages are free from obstructions and remove any particles which might later become dislodged and contaminate the oil system.

(3) After cleaning, dry passages with compressed air.

d. Electrical Cables and Flexible Hoses. Clean cables and flexible hoses with soap and water.

NOTE

Do not allow dry-cleaning solvent or mineral spirits paint thinner to be in prolonged contact with the rubber components and flexible hoses. These cleaners cause leather, rubber, and synthetic materials to dry, rot, and lose pliability, making them unserviceable.

e. Ball and Needle Bearings.

(1) Bearings require special attention in cleaning and oiling. After removing the surface dirt, oil or grease, the bearings, except the sealed, permanently lubricated type, should be placed in hot oil (about 150°F.) to loosen congealed oil and grease. After cleaning, the bearings should be wrapped tightly in oiled or waxed paper until inspection and assembly.

NOTE

Do not immerse sealed type ball bearings in dry-cleaning solvent (P-D-680, Type II), or hot oil. Entrance of cleaning agent will destroy lubricants sealed in bearing at time of manufacture. Loss of lubricant will result in premature failure of bearing and possible severe damage to the engine.

(2) Clean sealed ball bearings by wiping the exterior surfaces with a clean cloth moistened in dry-cleaning solvent (P-D-680, Type II). Compressed air must never be used in cleaning or drying of ball or needle bearings. Damage to bearings will result from spinning of bearing by air blast.

(3) Refer to TM 9-214 for information on inspection, care, and maintenance of bearings.

f. Painted Parts. The reconditioning of painted parts should be a matter of good judgment. Parts that appear to be in good condition after cleaning, need not be stripped and repainted in their entirety, but should be cleaned and designated for touch-up only. Parts that are rusted, or otherwise devoid of paint, must be stripped to bare metal. Rubber composition shroud seals must be removed and discarded before the parts can be stripped of paint.

3-37. Inspection

a. General. The engines are precision built and the repair standards tables have been fixed at extremely close limits. The following general instructions apply to all inspection procedures.

(1) Extreme care must be exercised in all phases of inspection.

(2) Inspect finish of all parts. Mark all parts that require refinishing.

b. Repair Standards. Key letters are used on the exploded views to locate points of measurement for repair limits. Each table contains the maximum, minimum, and key clearances of new or repair parts. The clearances, listed mainly for reference, will automatically be achieved if the mating parts are within the dimensional tolerances listed in the tables. In some cases, a part that is out of dimensional tolerance may be used, providing the mating part has been carefully selected and, when mated, is within the maximum clearance specified in the wear limits column of the tables. The wear limits indicate the point at which parts may be worn before replacement, in order to assure maximum service and minimum replacement. Normally, all parts which have not worn beyond dimensions shown in the "Wear Limits" column or are not damaged from corrosion, will be approved for service.

c. Symbols. Symbols employed in the repair Standards Tables are identified as follows:

* —An asterisk in the "Wear Limits" column indicates that the part must be replaced when worn beyond the limits given in the "Sizes and fits of new parts" column.

L —The letter "L", following the tolerance dimensions given in the "Sizes and fits of new parts" column and the "Wear limits" column, indicates a loose fit (clearance).

T —The letter "T", following the tolerance dimensions given in the "Sizes and fits of new parts" column and the "Wear limits" column, indicates a tight fit (interference).

d. Castings.

(1) Inspect all ferrous (cast iron, steel, etc.) castings for cracks. Inspect all nonferrous (aluminum) castings for cracks. Suspected cracks in the nonferrous casting can be checked with a magnifying glass (five power magnification minimum) and a strong light. Check particularly the areas adjacent to studs, pipe plugs, or threaded inserts and in sharp corners and fillets.

(2) Inspect machined surfaces of castings for nicks, burs, or raised metal. Mark damaged areas for repair.

(3) Check all mating flanges and mounting pads with a straight edge or surface plate for warpage. Inspect mating flanges and mounting pads for discoloration which may indicate persistant oil leakage.

(4) Inspect all tapped openings for stripped or damaged threads.

(5) Check all castings for conformance to applicable repair standards.

e. Ball and Needle Bearings. Refer to TM 9-214 for inspection of anti-friction bearings. Check all bearings for conformance to the applicable repair standards.

f. Studs. Inspect all studs for damaged or stripped threads, bent or loose condition, or for any signs of stretching.

g. Dowel Pins. Inspect dowel pins for looseness or damage. Mark loose pins for repair.

h. Gears and Shafts.

NOTE

There are no established wear limits for gear teeth and splines. Good judgment is required to determine need for replacement.

(1) Inspect all gears and shafts for cracks using a magnifying glass (five power magnification minimum) and a strong light.

(2) Inspect all gear teeth and splines for wear, sharp fins, burs, and galled or pitted surfaces.

(3) Inspect shaft and gear hub splines for damage, wear, and fit with splines on mating parts. Mating splines must match without binding or looseness.

(4) Check all gears and shafts for conformance to the applicable repair standards.

i. Bushings, Liners, and Bushing-type Bearings.

(1) Check all bushings, liners, and bushing-type bearings for secure fit in their respective casting or mating part, and for evidence of heating, which may be indicated by discoloration of bushing or bearing surface.

(2) Inspect for wear, burs, nicks or out-of-round condition.

(3) Check for dirt in lubrication holes or grooves. Holes and grooves must be clean and free from damage to insure proper lubrication.

(4) Inspect thrust faces of bushing-type bearings for wear and by temporarily assembling mating parts and checking end play with a feeler gage inserted between the thrust faces.

(5) Check for conformance to the applicable repair standards.

j. Oil Seals. Generally, metal encased oil seals are long-life parts and do not have to be replaced during repair if inspection indicates seals are in good condition.

(1) Inspect for damage to the thin feather edge of oil seal which contacts rotating part.

(2) Inspect sealing feather edge for softness and pliability.

(3) Replace damaged or questionable seals.

k. Helical-Coil and Screw-Thread Inserts

(1) *Description.* To permit higher stresses on studs and bolts which are set in aluminum castings, it is common practice to install inserts of a stronger metal into which the studs or bolts are threaded. Helical-coil and screw thread inserts are designated to perform this function. The inserts are spiral steel coils having a right hand thread-shaped form on the inside and on the outside diameter of the coils. A bar or tang at the bottom end of the coil, which is engaged by an inserting tool, is used for threading the insert into the casting. Some inserts have a serrated tooth section at the top end of the coil to stake them in place in the castings. Other inserts have turns at the center of the coil in the form of a hexagon. This provides a locking effect when the stud or bolt is threaded into the insert.

(2) *Inspection.* Inspect all helical-coil and screw thread inserts for secure fit in the casting and for galled or stripped threads.

l. Painted Parts. Straighten parts as necessary and check for broken welds, loose rivets or weld nuts. If parts are cracked or torn, they must be repaired or replaced. Check shroud seals for hardness, tears, or other damage. Mark damaged seals for replacement if the part is otherwise serviceable.

3-38. Repair

a. General. Most engine parts and components may be repaired as outlined below. After repair, clean all parts thoroughly to prevent metal chips from repair operations, or abrasives used in repair operations, from entering working parts of engine.

b. General Repair of Castings.

(1) Replace all castings when cracks have penetrated high stress areas such as fillets or webbing.

(2) Replace all castings which do not conform to tolerances specified in the appropriate repair standards table.

(3) Replace all castings on which machined surfaced are burred or nicked to the point of impairing subsequent assembly or operation. Repair minor damage to machined surfaces with a fine mill file or crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II).

(4) Replace all castings having flanges which are severely warped and cannot be repaired to provide a proper seating surface with its mating part. Repair minor warpage of mounting flanges and mounting pads by working surface across a sheet of crocus cloth held tightly on a surface plate or similar flat surface.

(5) Repair damaged pipe threads in tapped holes with a used tap.

NOTE

Pipe plug threads in castings must be in good condition to prevent oil leakage.

c. Ball and Needle Bearings.

(1) Replace all galled, pitted, or damaged bearings.

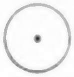
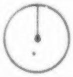
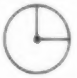
(2) Replace all bearings which do not conform to tolerances specified in the appropriate repair standards table.

(3) Refer to TM 9-214 for information on inspection, care, and maintenance of anti-friction bearings.

d. Studs. Replace all bent or loose studs or studs showing evidence of stretching. Repair minor damage with a thread chaser. Replace all studs having stripped or damaged threads. Remove and replace studs as outlined in (1) and (2) below.

(1) *Stud identification.* Stud identification tables appear in the repair sections of this chapter. Each table contains the appropriate information regarding stud setting heights, number required and reference figures of stud identification and location.

(2) *Removal.* Using a stud extractor, back studs out slowly to avoid heating and possible seizure. When studs are broken off too short to use extractor, drill stud and extract with a suitable remover. Short studs may also be removed by welding a piece of bar stock or a nut to stud and removing with a wrench.

STUD	STANDARD	0.003 OVERSIZE	0.007 OVERSIZE
COLOR CODE	NONE	RED	BLUE
MARK			

TA021526

Figure 3-141. Standard and oversize stud identification.

(3) *Replacement.*

(*a*) Repair minor thread damage in tapped holes with a used tap.

(*b*) When threads are stripped or damaged, or when stud was removed from an aluminum casting for loose fit, always replace stud with next larger oversize, or in cases of complete thread pullout, drill out threaded holes, tap hole for thread insert, install insert and standard stud for repair. Markings and color code indicates whether stud is standard or oversize. Check marking and color as shown in figure 3-141 to be sure replacement is of proper size.

NOTE

When the threads on each end of the stud are a different size, the coarse thread end must enter the aluminum casting.

(*c*) Studs available for replacement as shown in figure 3-141 are marked on the coarse thread end of stud.

(*d*) Apply a small amount of OE engine oil or GAA grease to threads before installing stud.

(*e*) Drive stud into tapped hole slowly to prevent heating. Drive to setting height given in appropriate table.

(*f*) When tapped holes in castings cannot be fitted with oversize studs, the holes in the castings can be fitted with helical-coil inserts (para 3-39) and studs of the original size can then be installed.

e. Dowel Pins. Replace loose dowel pins. If original dowel pin was only slightly loose, install new pin using sealing compound, Specification MIL-S-22473. In cases where the dowel pin hole is grossly out-of round, it will be necessary to drill the hole oversize, fashion a bushing, and install a new dowel pin in the bushing.

f. Painted Parts. Retouch or paint parts as necessary to produce an acceptable part. Retouch or repaint parts in their original color in accordance with procedures contained in TM 43-0139.

g. Gears and Shafts.

(1) Replace all cracked gears and shafts, and shafts that are bent or twisted.

(2) Replace all gears and shafts which do not conform to tolerances specified in the repair standards tables.

(3) Replace all gears and shafts having worn, galled, nicked, bured, or pitted teeth and splines. Remove any sharp fins and burs from splines with crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II).

(4) Replace all splined gears and shafts that are damaged to the point of impairing assembly or operation. Replace all gears and shafts having splines which do not match properly with mating splines.

h. Bushing, Liners, and Bushing-Type Bearings. When bushings, liners, and bushing-type bearings are damaged or worn beyond specified limits, generally the associated parts with which they are used must be replaced. Reference to (1) and (2), below, will be made in the repair section for the particular part when replacement of bushings, liners, and bushing-type bearings is required.

(1) *Removal.* Drill out bearing retaining pins when used to secure bearings in castings or retaining cages when applicable.

(2) *Installation.*

(*a*) Aline bushing, liner, or bushing-type bearing in casting or retaining cage. Press into place with a suitable pressing arbor.

(*b*) Select proper drill size for installation of bearing retaining pins. Drill through bearing and into casting or retaining cage to the proper depth so that the pin will be flush with the bearing surface after installation. Drive retaining pin through bearing and into casting or retaining cage. Cut off any portion of the pin that extends above bearing.

(*c*) Ream or burnish bushing liner, or bushing-type bearing to size specified in appropriate repair standards table.

(*d*) Clean repaired parts thoroughly before assembly or installation.

i. Oil Seals. Replace all oil seals at engine repair. During field repair, replace oil seal when thin feather edge is damaged or when seal has become hard or brittle.

(1) *Removal.* Press or pry damaged oil seal from casting or adapter.

(2) *Repair.* When oil seal bore in casting or adapter is bured or damaged to a point where an oil-tight seal is impossible, repair or replace casting or adapter. Remove slight nicks, burs, and scratches from oil seal bore in casting or adapter with crocus cloth dipped in dry-cleaning solvent or mineral spirits paint thinner.

(3) *Installation.* Install new oil seal in bore of casting or adapter.

3-39. Replacement of Helical-Coil and Threaded Inserts

a. General. Replace all helical-coil and screw thread inserts which do not fit securely in the casting or when casting threads have become galled or stipped.

b. Replacement. Replace all unserviceable helical-coil and screw thread inserts in the same manner as outlined in the following instruction. For instructional purposes helical-coil inserts in the cylinder assembly will be replaced.

(1) Use a diamond-shaped punch to remove the staked, serrated-tooth type section of insert (fig. 3-142) from the thread in cylinder casting.

(2) Install screw thread extractor — Part No. 7751056 into insert. Remove insert by applying constant pressure while turning extractor counterclockwise until insert is removed.

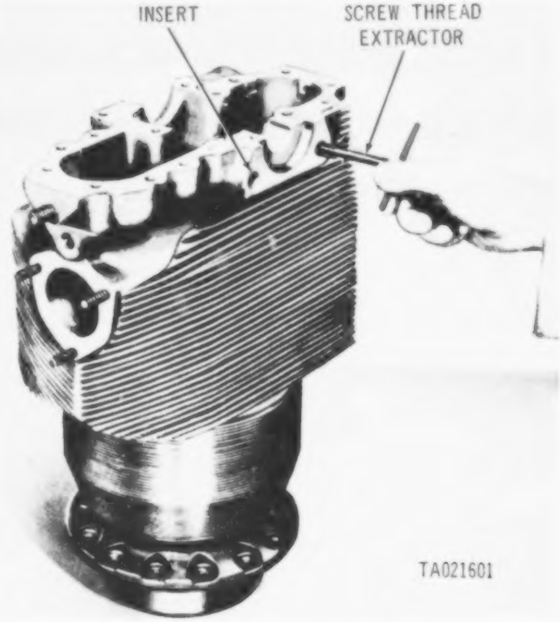


Figure 3-142. Removing helical-coil threaded insert from cylinder assembly using screw thread extractor.

NOTE

The special coil screw lock inserter tools listed in special tool table 2-1 must be used when installing the self-locking thread type inserts. These special inserters are further identified by painted areas marked either with a red handle or a red stripe around the body.

(3) Thread new insert (fig. 3-143) into the threaded guide of inserter Part No. MIL-T-21309 by slowly turning the pilot until insert is flush with the end of the tool. Insert the pilot of the screw thread inserter Part No. MIL-T-21309 into the threaded hole in cylinder, with face of the inserter resting solidly against the casting as shown.

(4) Slowly turn handle of pilot clockwise until no further resistance is felt. The insert will then be flush with cylinder casting. Remove inserter and break off helical-coil tang.

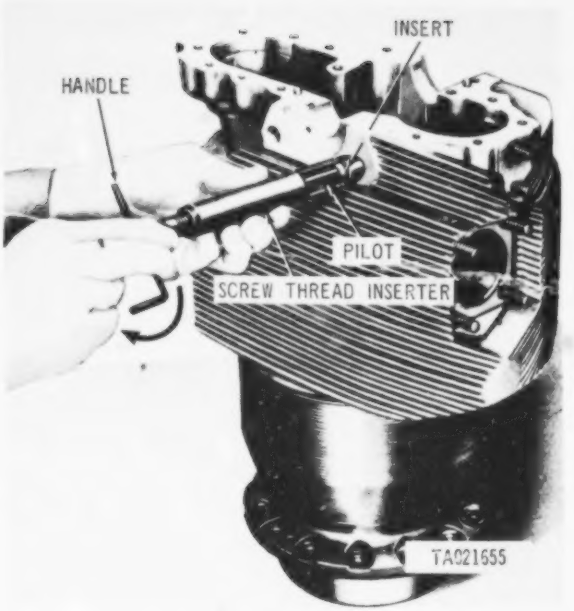


Figure 3-143. Installing helical-coil threaded insert in cylinder assembly using screw thread inserter.

3-40. Assembly

a. General. Extreme care must be exercised in all assembly operations to insure satisfactory engine performance. General rules for assembly are outlined below. Procedures for assembling the various components are covered in the paragraph relating to the specific component.

b. Precautionary Rules.

(1) Cleanliness is essential in all assembly operations. Dirt and dust, even in minute quantities, are abrasive. Parts must be cleaned as specified and kept clean. Wrap or cover parts and components when assembly procedures are not immediately completed.

(2) Coat all bearings, shafts, and all contact surfaces with oil (OE) to insure lubrication of parts during initial engine starting.

(3) Always use new gaskets and preformed packings when assembling engine.

(4) Use flat washers under all lockwashers, nuts and bolts to protect aluminum surfaces.

(5) Most bolts, capscrews, and nuts must be secured with lockwashers, tab washers, locking wire, or cotter pins, depending on method of locking specified.

(6) Whenever a locking method is not specified for bolts and capscrews, the mid-grip helical-coil threaded inserts into which the the bolts or screws are threaded serves as the locking device.

(7) It is also important that all hardware be tightened to the specified torque. Refer to torque specifications, paragraph 3-41.

3-41. Torque Specifications

a. Standard Torques for Studs and Bolts. Apply a light film of OE engine oil or GAA grease to studs, bolts, capscrew threads, and contact face of nuts, bolt heads, and capscrews. Avoid excessive amounts of compound in blind tapped holes.

Sizes (dia. in.)	*Torque* (lb.-in.)
1/4	75 - 100
5/16	150 - 175
3/8	275 - 325
7/16	400 - 450
1/2	550 - 600
9/16	800 - 850
3/4	1000 - 1050

b. Special Torques for Studs and Bolts. Apply a light film of OE engine oil or GAA grease to studs, bolts, capscrew threads, and contact face of nuts, bolt heads, and capscrews (except as noted). Avoid excessive amounts of compound in blind tapped holes.

Crankcase Tie-rod Stud	640 lb. in.
Main Bearing Stud	450 lb. in.

Crankcase Main Bearing Stud Nuts (Procedure):

(1) Tighten all nuts to 500 lb. in.

(2) Tighten all nuts to 700-825 lb. in.

(3) Check stud stretch, it must be 0.019 - 0.022 in.

(4) Tighten nuts as necessary to obtain proper stretch. Do not exceed 0.024 stretch when alining locking wire holes.

(5) All studs which exceed stretch limits at less than 700 pound-inches must be replaced. All studs which exceed the stretch limits above 700 pound-inches must be loosened and resubjected to operations (1), (2), (3), and (4), above.

NOTE

Retorquing any singular stud is not allowable. The adjacent stud must also be loosened and retorqued in sequence.

Component	*Torque value*
Accessory drive gear	400-450 lb. in.
Accessory drive housing base nuts and capscrews	275 lb. in.
Accessory drive housing to accessory drive housing base nuts	275 lb. in.
Camshaft bevel gear and cover	275-325 lb. in.
Camshaft drive inner gear plug	1300-1400 lb. in.
Connecting rod bolt nuts - alternately tighten to 100-150 lb. in., then to 600-650 lb. in., then to	1250-1300 lb. in.

Cylinder base nuts (use OE engine oil or GAA grease)	640 lb. in.
Cylinder head oil drain bolts	275-300 lb. in.
Cylinder head oil drain tube hose clamps	25-35 lb. in.
Damper housing to crankcase	225 lb. in.
Damper mounting capscrew	1000 lb. in.
Fan adapter to fan capscrews	150 lb. in.
Fan adapter to fan housing shaft nut	600 lb. in.
Fan housing base to crankcase nuts and capscrews	275 lb. in.
Fan housing to fan housing base nuts	275 lb. in.
Flared tube fitting tube nuts	
1/8-inch tubing, steel	75-85 lb. in.
1/4-inch tubing, steel	135-150 lb. in.
1/2-inch tubing, steel	450-500 lb. in.
Flared hose fittings	
No. 6 hose	240-260 lb. in.
No. 8 hose	325-350 lb. in.
No. 16 hose	375-400 lb. in.
Flywheel adapter bolts (Model AVDS-1790-2DR)	1000 lb. in.
Flywheel mounting capscrews	1000 lb. in.
Fuel adapter fitting bolt to injector nozzle	300 lb. in.
Fuel injector nozzle and retainer nut	500 lb. in.
Fuel injection pump base capscrews	750 lb. in.
Fuel injection pump capscrews	600 lb. in.
Fuel injection drive coupling hub nut	1000 lb. in.
Fuel injector tube clamps	175 lb. in.
Fuel injector tube nuts to pump head and nozzle	300 lb. in.
Fuel injector tube support nuts	125 lb. in.
Fuel return tube to adapter on injector nozzle holder	100 lb. in.
Fuel return tube to bulkhead tube cross fitting	100 lb. in.
Oil pan baffle capscrews	120-125 lb. in.
Oil pan mounting capscrews	175 lb. in.
Oil pan mounting nuts (no lubrication)	225 lb. in.
Oil pump cluster gear shaft nut	575-625 lb. in.
Oil pump drive gear nut	700-780 lb. in.
Oil pump to crankcase	275 lb. in.
Piston oiler nozzle to crankcase	125 lb. in.
Power takeoff drive coupling self-locking nut (late engines with 7/8-inch threads)	280-290 lb. ft.
Power takeoff drive coupling self-locking nut (early engines with 3/4-inch threads)	Prevailing torque plus 190 lb. ft.
Power takeoff spur gearshaft bolts	1000 lb. in.
Starter driven gearshaft nut	300 lb. ft.
Turbosupercharger oil inlet hose nipple	150 lb. in.
Valve rocker adjusting screw lock nut	175 lb. in.
Valve rocker cover bearing capscrews (4)	275-325 lb. in.
Valve rocker cover capscrew (except for bearing capscrews)	100 lb. in.

NOTE

On assemblies subjected to wire or cotter pin hole alinement, set torque wrench to low limit and torque nut. To facilitate alinement it is permissible to tighten nut to first hole beyond torque setting.

c. Standard Pipe Plug Torques (Using Thread Lubricant). Coat pipe plug threads with OE engine oil or GAA grease or equivalent.

Pipe thread size	*Torque (lb.-in.)*
1/8-27	60-80
1/4-18	125-145
3/8-18	185-215
1/2-14	250-280
3/4-14	305-345
1-11-1/2	500-1000

Section IV. REPAIR OF CRANKCASE ASSEMBLY

3-42. General

a. This section covers the repair of the crankcase assembly which consists of those parts that are machined with the crankcase. They include main bearing caps, oil seal housing, oil seal housing cap, and oil seal housing support. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedures. Stud identification tables are included where applicable.

b. The engine name plate (fig. 3-144), located on the right side of the crankcase, contains the engine serial number, model, fuel and oil specification. Any modifications to this information or addition of repair and modification kit data must be incorporated either on the engine name plate or on a modification tag mounted on a designated location elsewhere on the engine.

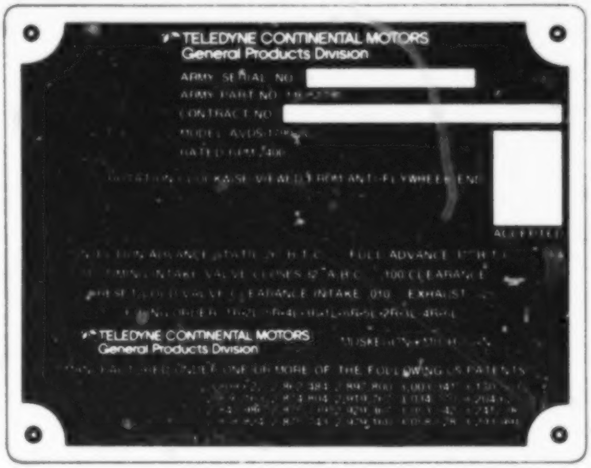

TELEDYNE CONTINENTAL MOTORS
General Products Division
ARMY SERIAL NO
ARMY PART NO
CONTRACT NO
MODEL AVDS-1790
ACCEPTED
FULL ADVANCE
INTAKE VALVE CLOSES
CLEARANCE
INTAKE .010 EXHAUST
TELEDYNE CONTINENTAL MOTORS
General Products Division
ONE OR MORE OF THE FOLLOWING US PATENTS
TA021806

Figure 3-144. Engine name plate.

3-43. Disassembly

a. Remove four main oil gallery pipe plugs (1, fig. 3-145), and one pipe plug (2) from inside of crankcase. Remove two pipe plugs (1, fig. 3-146) in the damper end of crankcase. Remove five pipe plugs (3) from crankcase oil gallery along the right side of crankcase. Remove two pipe plugs (2).

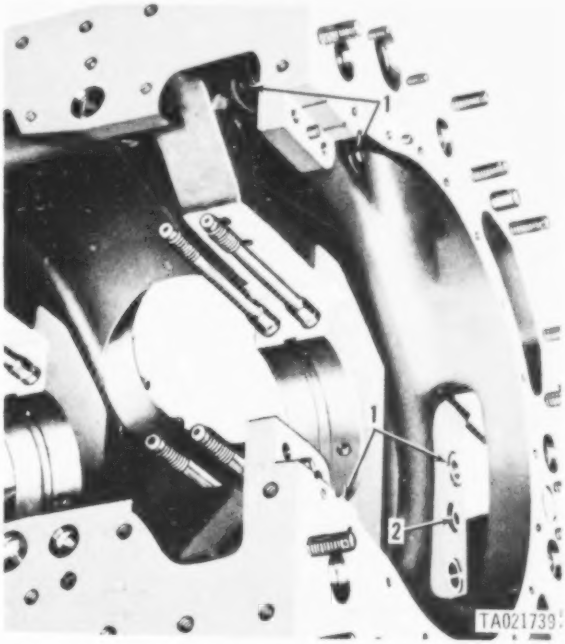
NOTE

Model AVDS-1790-2DR has four pipe plugs (3, fig. 3-146) in the main oil gallery.

b. Remove four bolts and flat washers attaching crankcase to engine overhaul stand. Attach a rope sling (fig. 3-147), with weight equally balanced, and remove crankcase from stand.

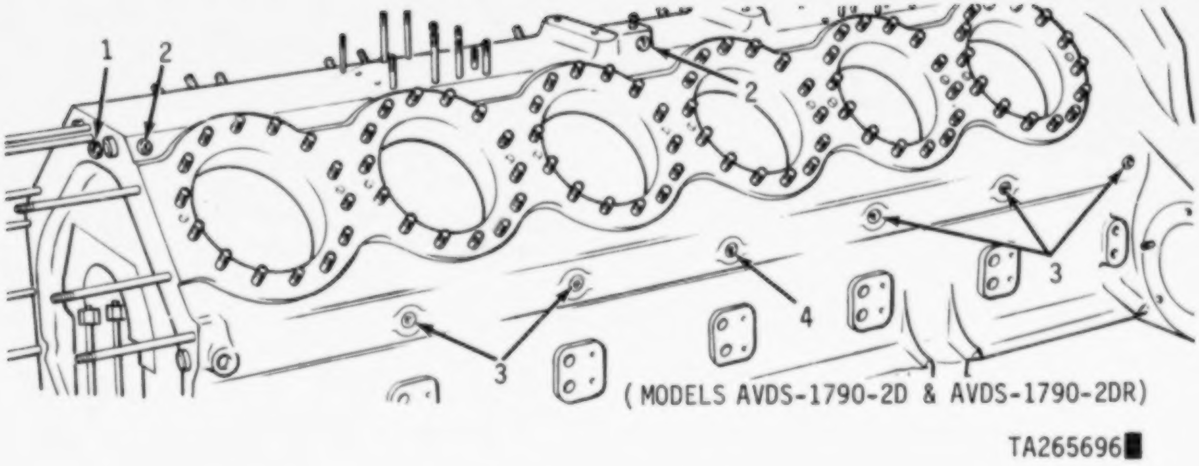
3-44. Cleaning

a. Refer to paragraph 3-36 for general instructions on cleaning the crankcase. Thoroughly clean crankcase oil passages (fig. 3-148) using compressed air and brass wire probes.


1
1
2
TA021739

1 Pipe plug
2 Pipe plug

Figure 3-145. Removing or installing pipe plugs.


1
2
2
3
4
3
(MODELS AVDS-1790-2D & AVDS-1790-2DR)
TA265696

1 Pipe plug	3 Pipe plug
2 Pipe plug	4 Pipe plug

Figure 3-146. Removing or installing crankcase oil gallery pipe plugs.

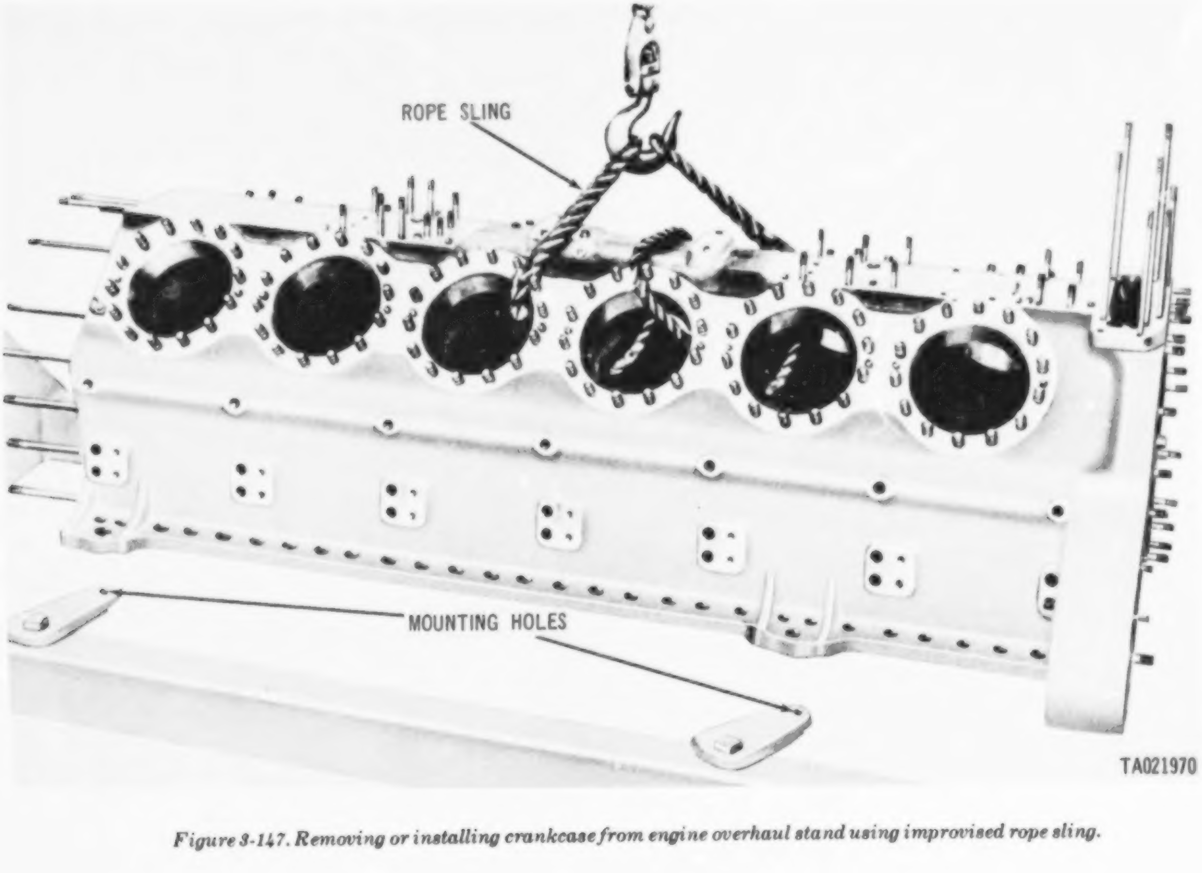

ROPE SLING
MOUNTING HOLES
TA021970

Figure 3-147. Removing or installing crankcase from engine overhaul stand using improvised rope sling.

b. Clean the main sleeve bearing halves with drycleaning solvent or mineral spirits paint thinner. Use a wooden scraper to remove sludge or gum deposits from bearing grooves and oil holes. Do not remove the bearing location markings made during engine disassembly.

3-45. Inspection

a. Castings. Inspect the crankcase oil seal housing (35, fig. 3-149), oil seal housing cap (4), oil seal housing support (28), main bearing caps (19 and 26), and related parts according to instructions covering castings in paragraph 3-37*b*, *c*, and *d*.

b. Inspect the engine crankcase rods (13, fig. 3-149), plate washers (12), nuts (11), and oil seal retainers (2) for damaged threads and other unserviceable conditions. Inspect injection pump base (2, fig. 3-150) according to instructions covering castings in paragraph 3-37*b*, *c*, and *d*. Inspect high oil pressure transmitter (1, fig. 3-150.1) and auxiliary generator high oil pressure switch (4) for damage. Replace all parts found unserviceable.

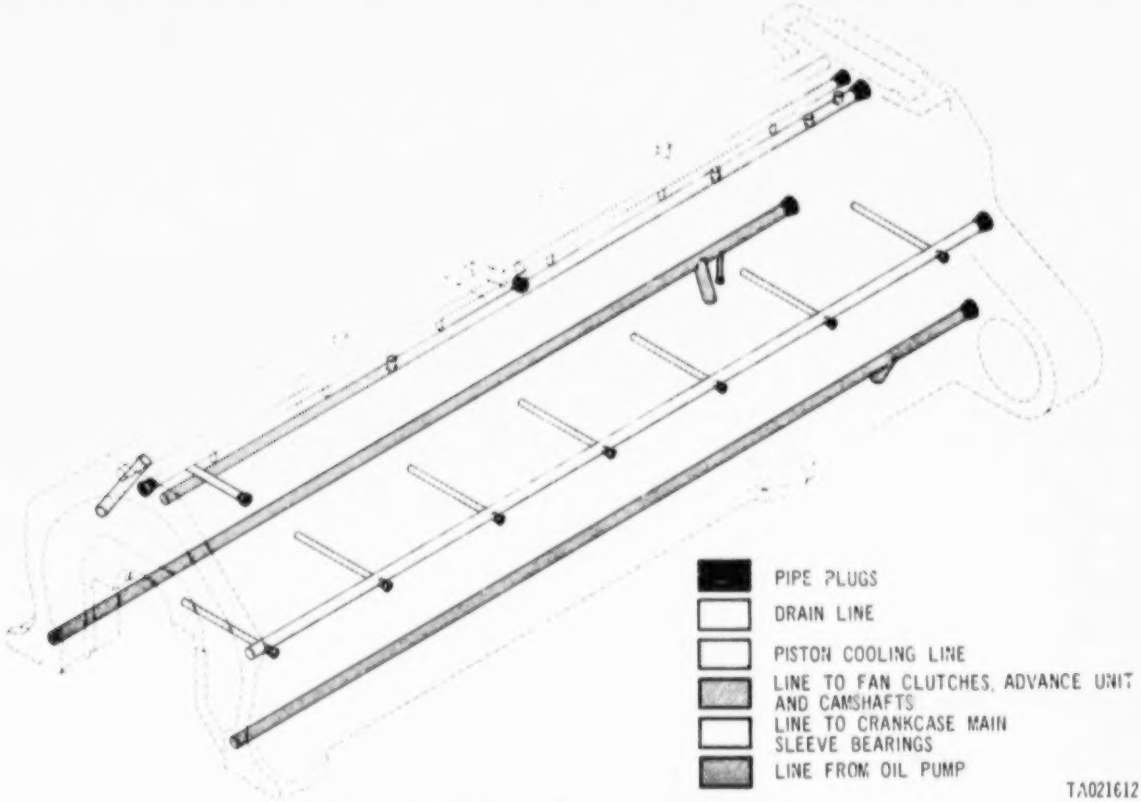
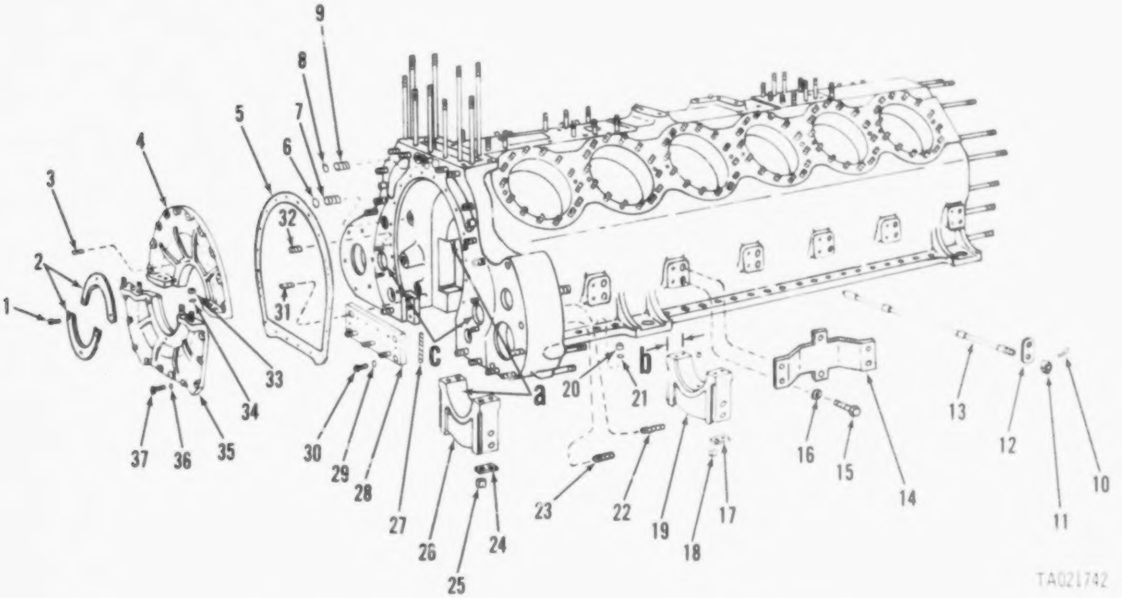

PIPE PLUGS
DRAIN LINE
PISTON COOLING LINE
LINE TO FAN CLUTCHES, ADVANCE UNIT AND CAMSHAFTS
LINE TO CRANKCASE MAIN SLEEVE BEARINGS
LINE FROM OIL PUMP
TA021612

Figure 3-148. Crankcase oil passages – schematic diagram.

c. Inspection of Main Sleeve Bearings.

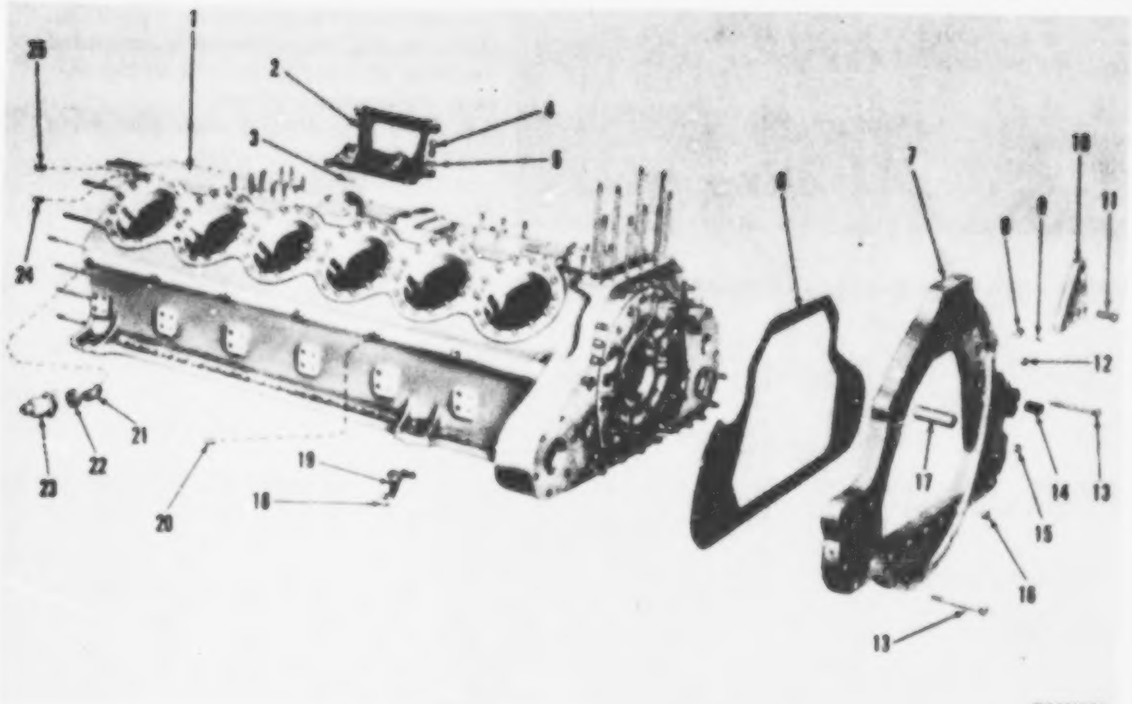
(1) Inspection of main sleeve bearing surfaces is largely a matter of judgment and experience. The following instructions will assist in determining whether a bearing is serviceable or whether it should be replaced. Replace any questionable bearings. Separation bearing metal, or signs of possible separation, requires that the bearing be replaced.

(2) Fine scratches on sleeve bearing are not cause for rejection. Pitting or any other form of destruction to the bearing surface is cause for rejection. Replace bearings showing raised metal at



1 Bolt
2 Oil seal retainer
3 Insert
4 Crankshaft oil seal housing cap
5 Crankshaft oil seal housing gasket
6 Expansion plug
7 Pipe plug
8 Expansion plug
9 Pipe plug
10 Cotter pin
11 Slotted nut
12 Plate washer
13 Engine crankcase rod
14 Angle bracket
15 Machine bolt
16 Lockwasher
17 Flat washer
18 Slotted nut
19 Bearing cap
20 Self-locking nut
21 Flat washer
22 Pipe plug
23 Pipe plug
24 Flat washer
25 Slotted nut
26 Bearing cap
27 Packing
28 Support
29 Flat washer
30 Capscrew
31 Insert
32 Insert
33 Slotted nut
34 Flat washer
35 Oil seal housing
36 Flat washer
37 Bolt

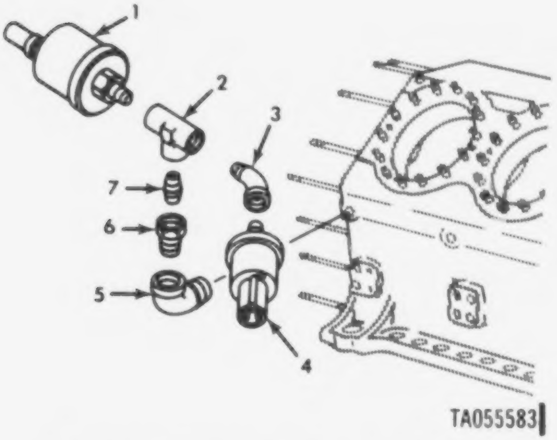
Figure 3-149. Crankcase and associated parts – exploded view.



1 Crankcase assembly
2 Injection pump base
3 Oil transfer tube preformed packing
4 Capscrew
5 Lockwasher
6 Transmission adapter gasket
7 Transmission adapter
8 Engine timing pointer (Models AVDS-1790-2C and AVDS-1790-2D only)
9 Timing pointer bolt (Models AVDS-1790-2C and AVDS-1790-2D only)
10 Engine lifting eye
11 Lifting eye bolt
12 Nut
13 Bolt
14 Turbocharger support mount
15 Self-locking nut
16 Nut
17 Dowel pin (Models AVDS-1790-2C and AVDS-1790-2D only)
18 Slotted nut
19 Piston oil sprayer nozzle
20 Pipe plug
21 Elbow (Models AVDS-1790-2C and AVDS-1790-2D only)
22 Pipe bushing (Models AVDS-1790-2C and AVDS-1790-2D only)
23 Engine high oil pressure transmitter (AVDS-1790-2C and AVDS-1790-2D only)
24 Pipe plug
25 Pipe plug

Figure 3-150. Crankcase and associated parts – exploded view.

edges of scratches. Minute pieces of metal and dirt particles embedded in bearing surfaces are not cause for rejection.



1 High oil pressure transmitter
2 Tee
3 Pipe elbow
4 Auxiliary generator high oil pressure switch
5 Pope elbow
6 Bushing
7 Nipple

Figure 3-150.1. Pressure transmitter and pressure switch – exploded view, model AVDS-1790-2DR engine.

NOTE

Do not attempt to remove such particles. However, if a concentration of embedded particles affects five percent of the surface, replace the bearings.

d. Stud (Tie Rod) Torque and Main Bearing Bore Inspection.

NOTE

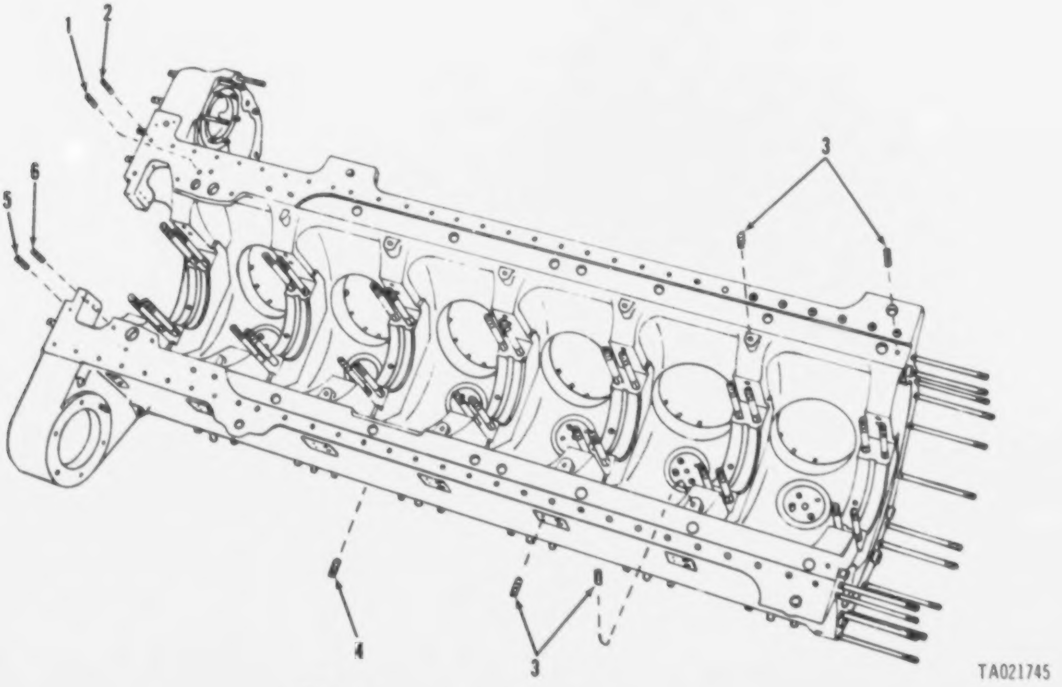
Main bearing sleeve halves should be installed in their original location when they are to be reused. Use new bearings when a visual inspection indicates bearings are unserviceable. Use only new or serviceable bearings for main bearing bore check.

(1) Install crankcase on engine overhaul stand using a rope sling (fig. 3-147) and secure with four bolts and flat washers.

(2) Check main bearing cap stud torque using a torque wrench as shown in figure 3-152. Torque on studs must be 450 pound-inches. Studs that do not tighten to specified torque must be removed for further inspection. Refer to table 3-2 when replacing studs.

NOTE

Never tighten main bearing studs above recommended torque.



1 Pipe plug
2 Insert screw thread
3 Insert screw thread
4 Pipe plug
5 Insert screw thread
6 Insert screw thread

Figure 3-151. Crankcase and associated parts – exploded view.

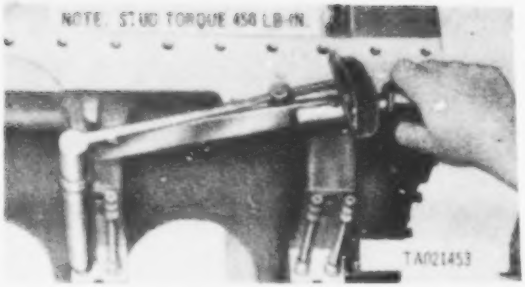


Figure 3-152. Checking torque of main bearing cap studs.

(3) Spread a thin coat of Prussian blue Part No. MIL-P-20501, over steel backs of upper and lower main sleeve bearing halves to show the sleeve bearing contact surface with the main bearing bore in crankcase. Install bearings in their original location in crankcase and main bearing caps.

(4) Check clearance between upper bearing flange and crankcase. Install upper main thrust sleeve bearing into No. 4 main bearing seat of crankcase. Measure clearance between bearing flange and crankcase using feeler gage (fig. 3-153). Clearance should be 0.004 to 0.008 inch.

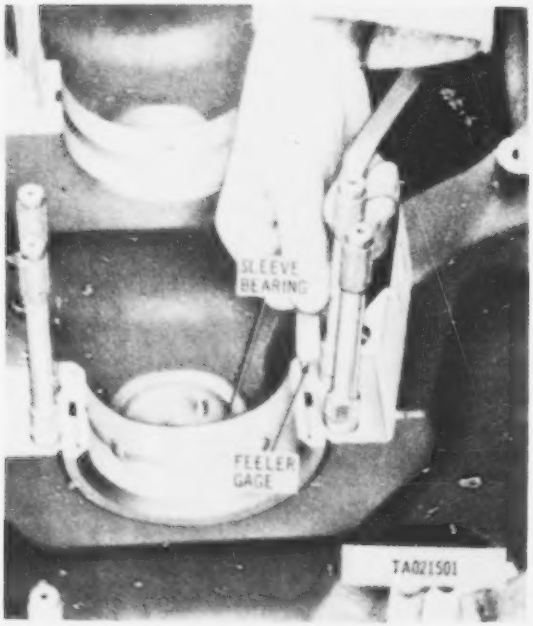


Figure 3-153. Checking clearance between upper main thrust bearing flange and crankcase.

(5) Check clearance between the lower main thrust bearing flange and thrust bearing cap in the same manner as shown in figure 3-153.

(6) Apply a light coating of engine oil to the ends of the seven main bearing caps with sleeve bearing halves installed. Using crankcase spreading tool Part No. 8708361, as shown in figure 3-130, install the bearing caps with bearing halves in their proper locations in the crankcase, according to the location number stamped on the crankcase and cap. The side of the bearing cap marked "FLY END" must face the rear of the crankcase.

(7) Apply a small amount of OE 30 engine oil or GAA grease to the threaded area of each main bearing cap stud. Install a plate washer on each pair of main bearing studs. Install a slotted nut on each main bearing stud but do not tighten nuts at this time.

(8) Place a surface plate and dial indicator gage on crankcase flange with gage indicator resting on end of stud. Measure and record height of each stud. Torque tighten main bearing stud nuts to 500 pound-inches. Alternately tighten all four nuts on each main bearing to a torque of 700-825 pound-inches. Measure the height of each stud after final torque. The difference between the stud height before and after torque tightening indicates stud stretch. Normal stud stretch is 0.019 to 0.022 in. Apply additional torque to obtain a stud stretch of 0.019 to 0.022. Do not exceed 0.024. If any stud has stretched more than 0.024 in. at 700 pound-inches torque, it must be replaced. Refer to table 3-2 when replacing studs.

(9) Install the 14 engine crankcase rods (13, fig. 3-149) in the holes provided through the crankcase and main bearing caps. Equalize the extension of the threaded portions of the rods on each side of the crankcase. Apply a small amount of OE 30 engine oil or GAA grease to the threaded portions of each rod. Install a plate washer and a 9/16 slotted nut on each end of the rods (12 and 11, fig. 3-149).

(10) Starting at the main thrust bearing cap, with aid of an assistant to hold the nuts on the opposite side of crankcase. alternately tighten all main bearing cap engine crankcase rod nuts to 640 pound-inches torque.

(11) Check the inside diameter of the main bearings with a dial bore indicator as shown in figure 3-154 against the limits specified in repair standards (table 3-1). Replace bearings which do not meet these requirements. New bearings must also be dial bore checked. Remove the main bearing caps and bearing halves from the crankcase and check contact surfaces as indicated by Prussian transfer. Replace bearings that do not make 75 percent contact with crankcase bearing bores. Repeat dial bore check of new bearings installed.

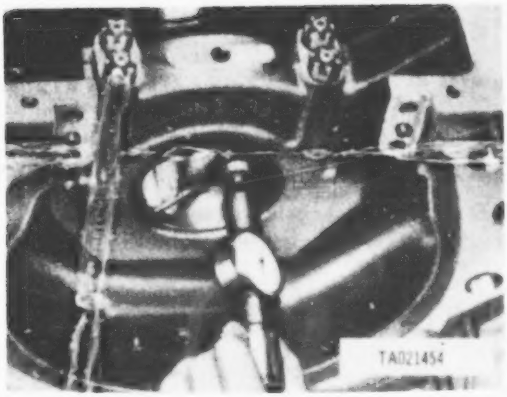


Figure 3-154. Checking inside diameter of main bearings.

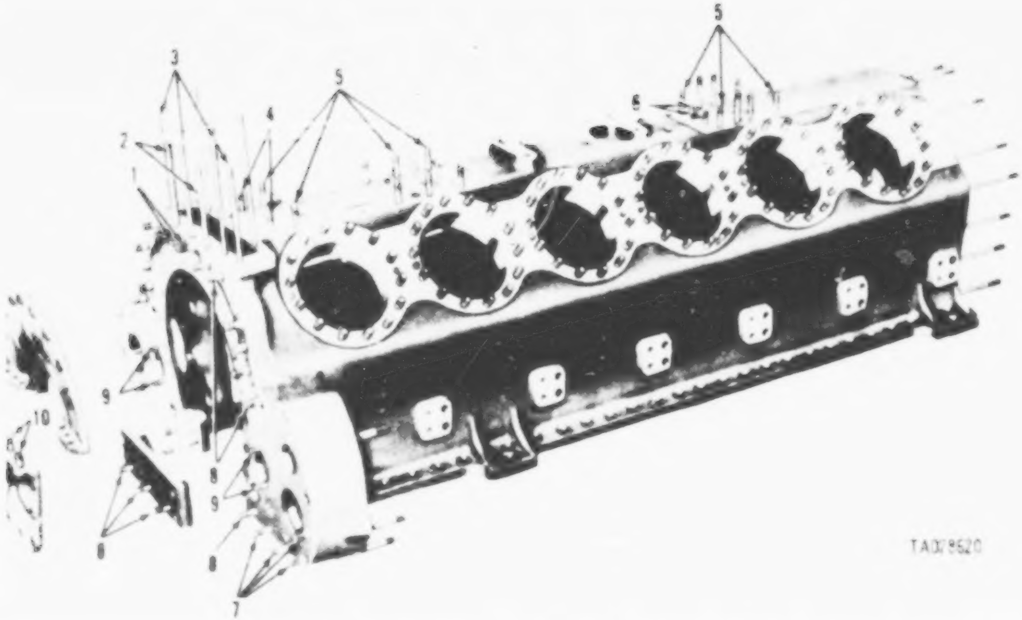
Table 3-1. Crankcase Assembly Repair Standards

Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
3-149	a	Inside diameter of bearing bore in crankcase	4.7533	4.7538	*
3-149	b	Outside width of main thrust bearing cap and thrust bearing surface in crankcase	2.0240	2.0260	*
3-149	c	Inside diameter of starter idler gear and generator idler gear shaft bores in crankcase	1.1808	1.1818	1.1824
3-167	a and q	Outside pilot diameter of starter idler gear shaft and generator idler gear shaft	1.1804	1.1808	1.1802
3-167	a and q-c	Fit of starter idler gear shaft and generator idler gear shaft pilots in crankcase bores	0.0000	.0014L	.0022L
3-174	e	Thickness of main bearing half at center (refer to 3-174, d-c, below)	0.2492	0.2499	
3-174	x	Thickness of main bearing half 1/2 inch from ends (to be 0.0005 to 0.0010 less than at center "e")			
3-174	d	Inside diameter of main bearing at proper torque tightness (90 degrees to split line) (STD)	4.2545	4.2575	4.2585
		0.003 undersize	4.2515	4.2545	4.2555
		0.010 Undersize	4.2445	4.2475	4.2485
3-174	f	Inside width of main thrust bearing face	2.0300	2.0320	*
3-149	f-b	Fit of main thrust bearing over bearing cap and thrust bearing surface in crankcase	0.0040L	0.0080L	*
3-174	c-d	Fit (oil clearance) of bearings on journals (refer to table 3-8)	0.0040L	0.0080L	0.0100L
3-174	v	Outside width of main thrust bearing	2.4860	2.2880	2.4840
3-174	w	Thickness of main thrust bearing flange (refer to 3-174, d-c, above)	0.2270	0.2290	
3-167	j	Inside diameter of bearing bore in crankcase liner (starter)	2.8346	2.8353	2.8356
3-167	p	Inside of diameter of bearing bore in crankcase liner (generator)	2.8346	2.8353	2.8356
3-174	v-g	Fit (crankshaft end play) of thrust bearing in journal (refer to table 3-8)	0.0110L	0.0150L	0.0190L

Refer to paragraph 3-37c for explanation of symbols.

3-46. Repair

Repair or replace damaged parts. Refer to paragraph 3-38*d*, table 3-2, and figures 3-155 through 3-157 when replacing crankcase studs.


5
3
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9
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TA078520

Figure 3-155. Crankcase studding, ¾ left rear-exploded view.

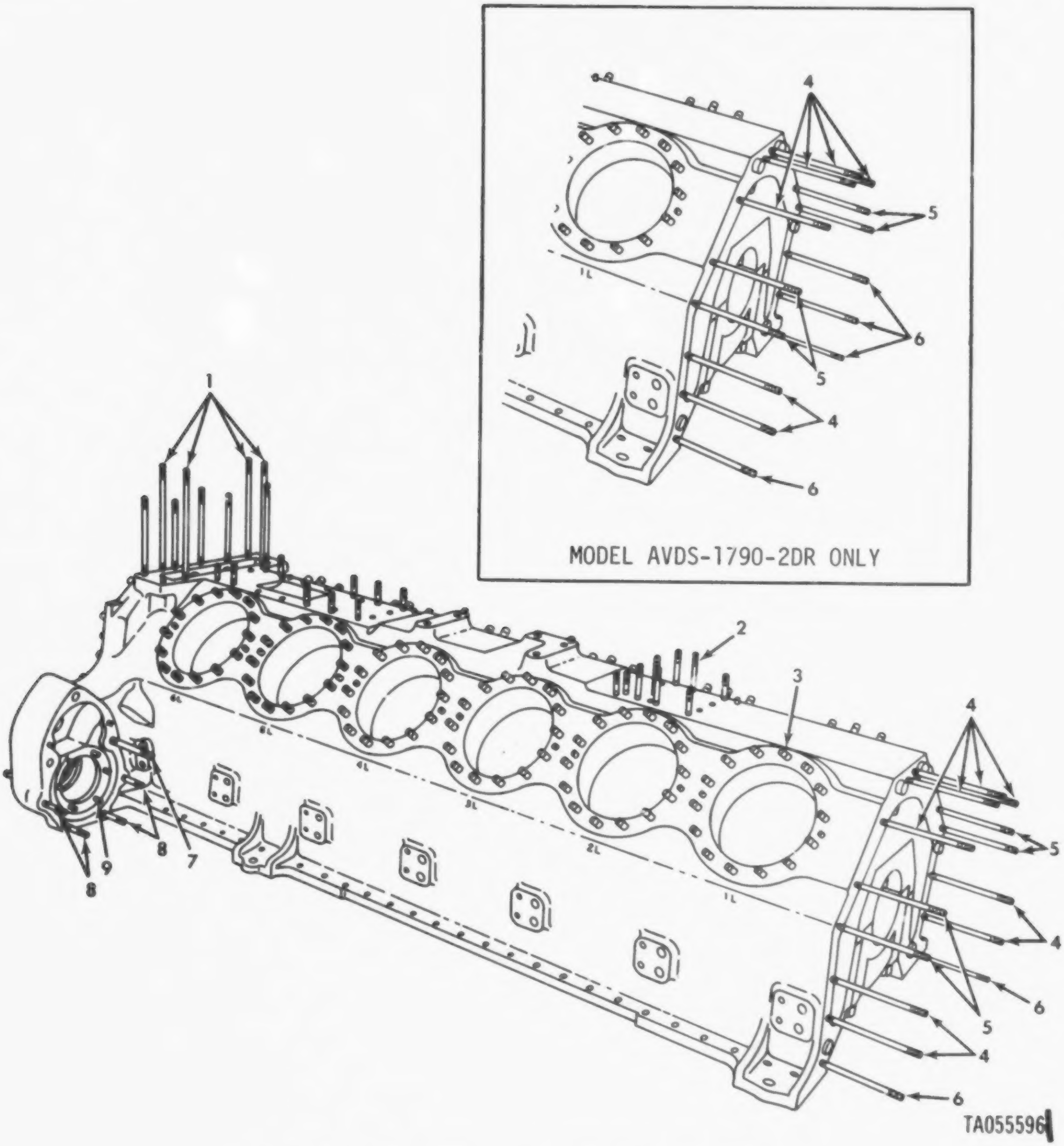

MODEL AVDS-1790-2DR ONLY
1
2
3
4
5
6
7
8
9
TA055596

Figure 3-156. Crankcase studding, ¾ left front view, model AVDS-1790-2C and AVDS-1790-2D engines.

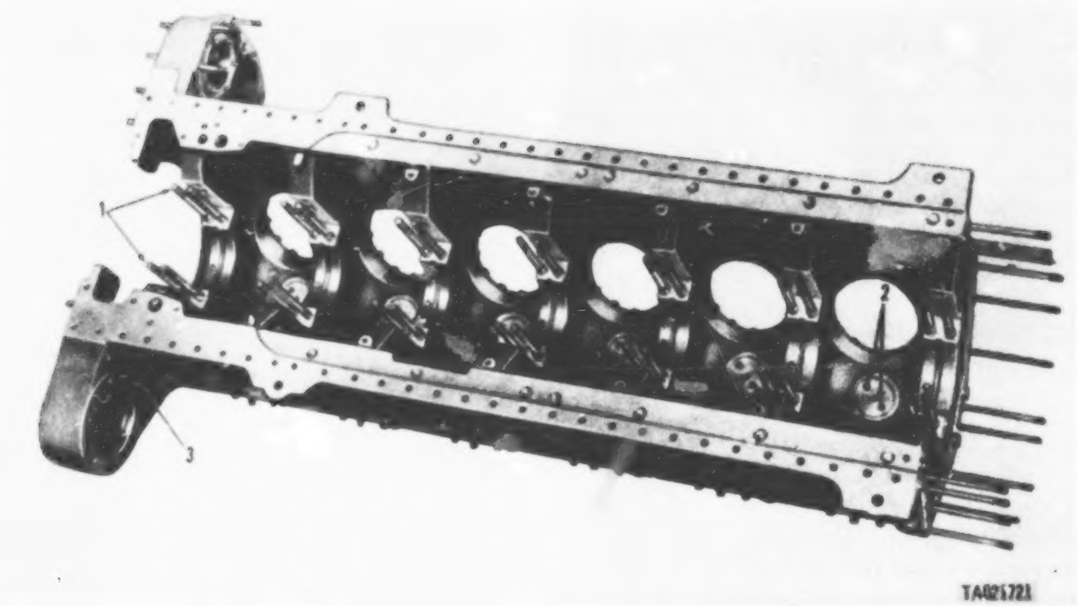


Figure 3-157. Crankcase studding – bottom view.

Table 3-2. Crankcase Standard Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-155	1	31/32	2	3/8-16 (27/32) x 3/8-24 (7/8) x 1-3/4
3-155	2	5-7/16	2	3/8-16 (15/16) x 3/8-24 (13/16) x 6-1/4
3-155	3	6-1/8	3	3/8-16 (15/16) x 3/8-24 (13/16) x 6-7/8
3-155	4	1-7/32	2	3/8-16 (15/16) x 3/8-24 (13/16) x 2
3-155	5	1-5/8	12	3/8-16 (29/32) x 3/8-24 (11/16) x 2-1/4
3-155	6	31/32	2	3/8-16 (27/32) x 3/8-24 (7/8) x 1-3/4
3-155	7	1-11/32	4	7/16-14 (1) x 7/16-20 (3/4) x 2-1/4
3-155	8	1-1/8	15	1/2-13 (13/16) x 1/2-20 (15/16) x 2-1/4
3-155	9	9/16	4	5/16-18 (19/32) x 5/16-24 (17/32) x 1-1/8
3-155	10	31/32	4	5/16-18 (51/64) x 5/16-24 (21/32) x 1-5/8
3-156	1	8-5/16	4	3/8-16 (15/16) x 3/8-24 (13/16) x 9-1/8
3-156	2	2-29/64	4	3/8-16 (15/16) x 3/8-24 (13/16) x 3-1/4
3-156	3	15/16	168	1/2-13 (63/64) x 1/2-20 (3/4) x 2-1/8
3-156	4	5-1/2	8*	3/8-16 (1) x 3/8-24 (1-3/16) x 6-1/4
3-156	5	5-1/16	4	3/8-16 (27/32) x 3/8-24 (1) x 6
3-156	6	5-1/4	2**	3/8-16 (3/4) x 3/8-14(1) x 5-7/8
3-156	7	4-19/32	1	5/8-11 (1-11/32) x 5/8-18 (29/32) x 5-1/2
3-156	8	2-1/2	4	3/8-16 (15/16) x 3/8-24 (11/16) x 3-1/8
3-156	9	1/2	6	5/16-18 (1/2) x 5/16-24 (7/16) x 1
3-157	1	6-5/64	28	9/16-12 (1-3/8) x 9/16-18 (1-13/64) x 8-3/4
3-157	2	17/32	12	5/16-18 (19/32) x 5/16-24 (17/32 x 1-1/8
3-157	3	15/16	1	7/16-14 (1) x 7/16-20 (3/4) x 1-3/4

*Model AVDS-1790-2DR, 6 required.
**Model AVDS-1790-2DR, 4 required.

3-47. Assembly

a. Install one pipe plug (4, fig. 3-146) Model AVDS-1790-2D only. Install five pipe plugs (3) in crankcase oil gallery along right side of crankcase. Install one pipe plug (2). Install two pipe plugs (1) in damper end of crankcase.

a. 1. Install one pipe plug (4, fig. 3-146). Install four pipe plugs (3) in the oil gallery holes located on right side of crankcase except between the mounting pads for cylinder Nos. 2R and 3R. Install one pipe plug (2). Install two pipe plugs (1) in damper end of crankcase. Install a pipe bushing in the oil gallery opening located below and between the mounting pads for cylinder Nos. 1R and 2R. Install a 90° elbow in the bushing with leg directed toward the front of the engine, refer to figure 3-180.1.

b. Install one pipe plug (2, fig. 3-145) and four pipe plugs (1) in main oil gallery.

SECTION V. REPAIR OF TRANSMISSION ADAPTER, STARTER, AND GENERATOR DRIVE COMPONENTS

3-48. General

This section covers the repair of the transmission adapter, starter and generator drive components. These procedures include disassembly, cleaning, inspection, repair, and assembly.

3-49. Transmission Adapter

a. Disassembly.

(1) Remove two bolts (6, fig. 3-158) attaching lifting eye (3) to transmission adapter (7). Remove lifting eye. Cut locking wire and remove two bolts (5) attaching timing pointer to adapter. Remove timing pointer.

(2) Do not remove the two dowel pins (2) or the two resilient mounts (1) unless inspection shows replacement necessary. To remove dowel pin or resilient mounts, press from adapter using an arbor press.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38.

c. Assembly.

(1) If dowel pins (2, fig. 3-158) or resilient mounts (1) were removed from transmission adapter (7), install new parts using an arbor press.

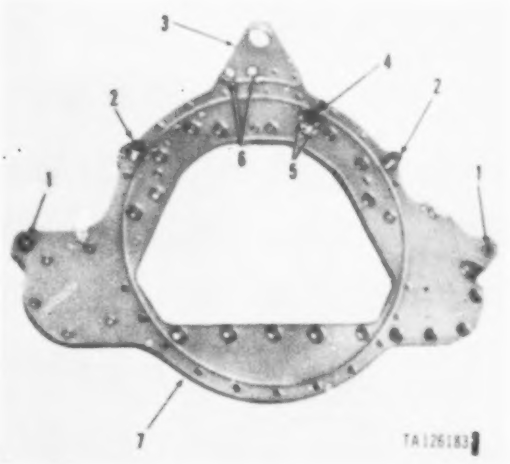
(2) Position timing pointer (4) on adapter and install two bolts (5) securing pointer on adapter. Install locking wire securing bolts. Position lifting eye (3) on adapter and install two bolts (6) securing lifting eye on adapter.

3-50. Starter Drive

a. Disassembly.

(1) Press the starter driven gearshaft from bearing cage. Using a suitable arbor press (fig. 3-159), remove oil seal from the bearing cage. Discard oil seal.

(2) Press starter driven gearshaft (fig. 3-160) from upper ball bearing and press gearshaft from lower ball bearing in a similar manner.



1 Resilient mount
2 Dowel pin (Models AVDS-1790-2C and AVDS-1790-2D only)
3 Lifting eye
4 Timing pointer (Models AVDS-1790-2C and AVDS-1790-2D only)
5 Bolt (Models AVDS-1790-2C and AVDS-AVDS-1790-2D only)
6 Bolt
7 Transmission adapter

Figure 3-158. Removing or installing transmission adapter lifting eye and timing pointer.

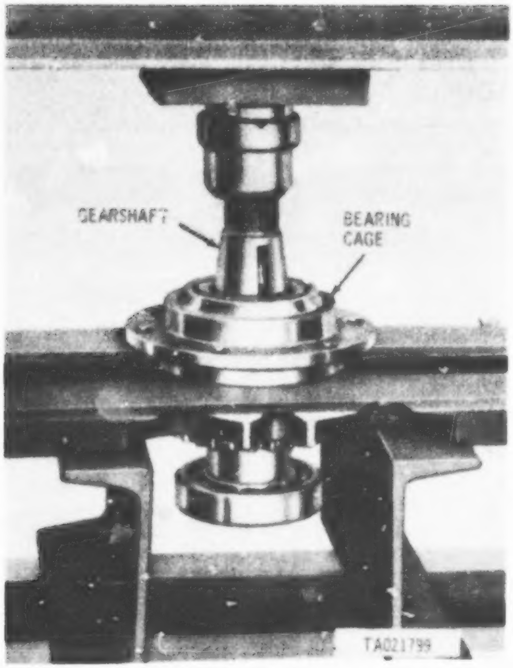


Figure 3-159. Pressing starter driven gearshaft and bearings from bearing cage.

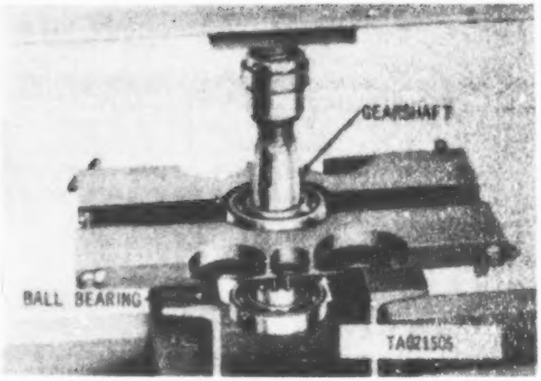


Figure 3-160. Pressing starter driven gearshaft from ball bearing.

b. Cleaning, Inspection, and Repair.

(1) Refer to paragraphs 3-36 through 3-38.

(2) Inspect starter driven gearshaft, oil seal, and bearings against limits specified in repair standards (table 3-3). Replace parts not meeting these requirements.

Table 3-3. Starter Driven Gearshaft Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Starter drive gearshaft oil seal	3-167	e	Outside diameter of oil seal	2.1270	2.1310	•
	3-167	f	Inside diameter of seal bore in cage.	2.1240	2.1260	•
	3-167	f-e	Fit of seal in cage	0.0010T	0.0070T	•
Starter driven gearshaft bearing	3-167	b	Outside diameter of bearings	2.8341	2.8346	•
	3-167	c	Inside diameter of bearing bore in cage	2.8346	2.8353	2.8356
	3-167	b-c	Fit of bearing in cage	0.0000	0.0012L	0.0015L
	3-167	j	Inside diameter of bearing bore in crankcase liner	2.8346	2.8353	2.8356
	3-167	b-j	Fit of bearing in crankcase	0.0000	0.0012L	0.0015L
	3-167	g	Inside diameter of bearing	1.3775	1.3780	•
	3-167	h	Outside diameter of bearing hubs on gearshaft.	1.3781	1.3785	1.3779
	3-167	g-h	Fit of bearings on gearshaft hubs.	0.0001T	0.0010T	0.0001L
	3-167	d	Tooth width of starter drive gear.	0.8700	0.8900	•

Refer to paragraph 3-37*c* for explanation of symbols.

c. Assembly.

(1) Coat ball bearing with engine oil and position bearing on bearing flange of gearshaft. Press lower ball bearing (fig. 3-161) on gearshaft using a suitable pressing sleeve on inner race of bearing. Coat upper ball bearing with engine oil and press bearing on opposite end of gearshaft in the same manner.

(2) Coat new oil seal with engine oil. Position seal on bore of bearing cage with lip of seal towards ball bearing seat. Carefully press oil seal (fig. 3-162) into cage until seal is tight against seal seat flange. Press starter driven gearshaft in the bearing cage.

3-51. Generator Drive

a. Model AVDS-1790-2C Engine.

(1) *Disassembly.* Press generator drive gearshaft (fig. 3-163) from rear ball bearing using a

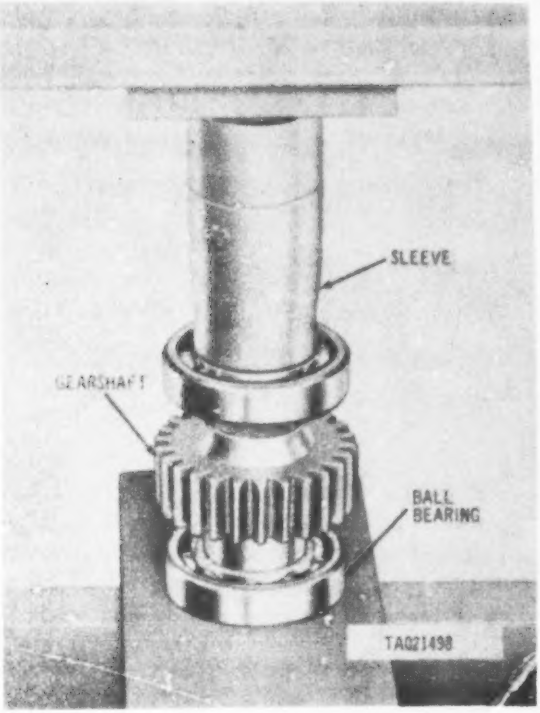

SLEEVE
GEARSHAFT
BALL BEARING
TA021498

Figure 3-161. Pressing ball bearings on starter driven gearshaft.

suitable arbor press. Press gearshaft from the front ball bearing in a similar manner.

(2) *Cleaning, inspection, and repair.* Refer to paragraphs 3-36 through 3-38.

(*a*) Secure generator holding tool (7, fig. 2-5 to workbench. Remove "V" band clamp from generator holding tool. Remove two plain nuts and lockwashers and remove adapter and plate from holding tool base. Place generator drive gearshaft in base with gear teeth meshed with those in the base.

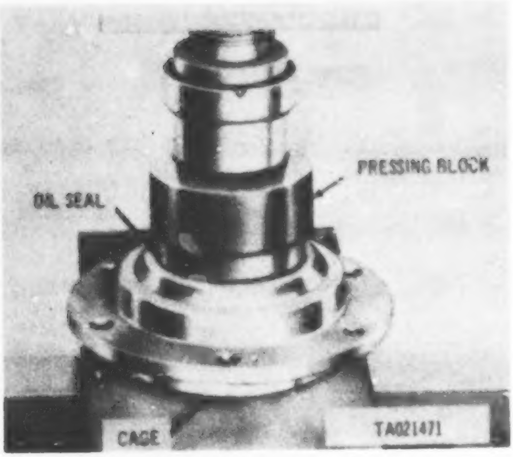

PRESSING BLOCK
OIL SEAL
CAGE
TA021471

Figure 3-162. Pressing oil seal into bearing cage.

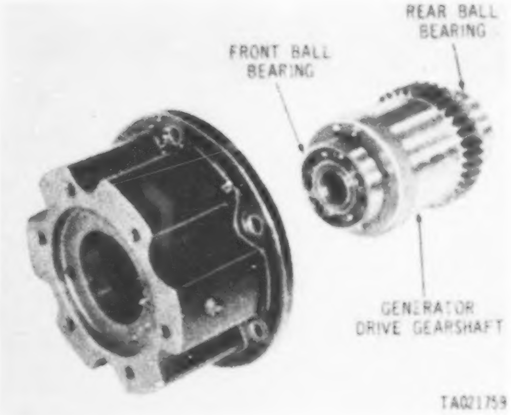
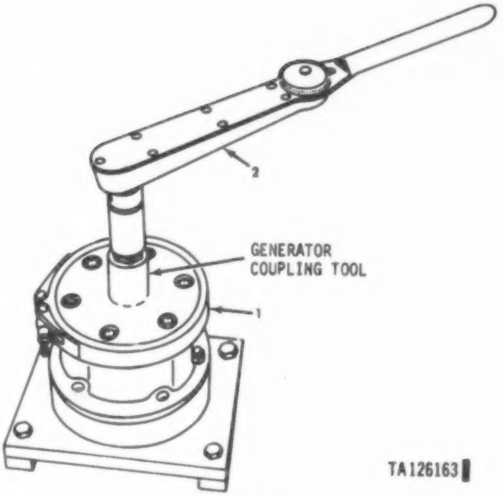

REAR BALL BEARING
FRONT BALL BEARING
GENERATOR DRIVE GEARSHAFT
TA021759

Figure 3-163. Pressing generator drive gearshaft from ball bearings. Model AVDS-1790-2C Engine.

Install adapter and plate and secure with two plain nuts and lockwashers removed above. Install splined end of generator coupling tool (8, fig. 2-5) on plate and secure with clamp (1, fig. 3-163.1) removed above. Using a 300 pound-feet capacity torque wrench (2), gradually increase the torque to 167 pound-feet. If slippage occurs below 167 pound-feet, the gearshaft is defective and must be replaced. Check torque rotational deflection rate. Using same coupling and torque wrench, apply 167 pound-feet torque. Note deflection in degrees from zero torque to 167 pound-feet torque. If rotation is less than 8°, or greater than 17°, the gearshaft is defective and must be replaced. Inspect gearshaft and bearings against limits specified in the repair standards (table 3-4). Replace parts not meeting these requirements.



1 "V" band clamp
2 Torque wrench

Figure 3-163.1. Checking generator drive gearshaft for slippage and rotational deflection.

Table 3-4. Generator Drive Repair Standards, Model AVDS-1790-2C

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Generator drive gearshaft, oil seal and bearings	3-167	m	Outside diameter of bearings on generator drive gearshaft	2.8341	2.8346	*
	3-167	k	Inside diameter of bearing bore in adapter	2.8346	2.8353	2.8356
	3-167	m-k	Fit of bearing in adapter	0.0000	0.0012L	0.0015L
	3-167	p	Inside diameter of bearing bore in crankcase liner	2.8346	2.8353	2.8356
	3-167	m-p	Fit of bearing in crankcase	0.0000	0.0012L	0.0015L
	3-167	n	Outside diameter of bearing hubs on gearshaft	1.3781	1.3785	1.3779
	3-167	ee	Inside diameter of bearings	1.3775	1.3780	*
	3-167	ee-n	Fit of bearings on gearshaft	0.0001T	0.0010T	0.0001L

Refer to paragraph 3-37c for explanation of symbols.

(3) *Assembly.* Coat all bearings with engine oil and press rear and front ball bearings on generator drive gearshaft.

b. Model AVDS-1790-2D and AVDS-1790-2DR Engines.

(1) *Disassembly.*

(a) Press generator adapter oil seal (fig. 3-164) from adapter using a suitable arbor press.

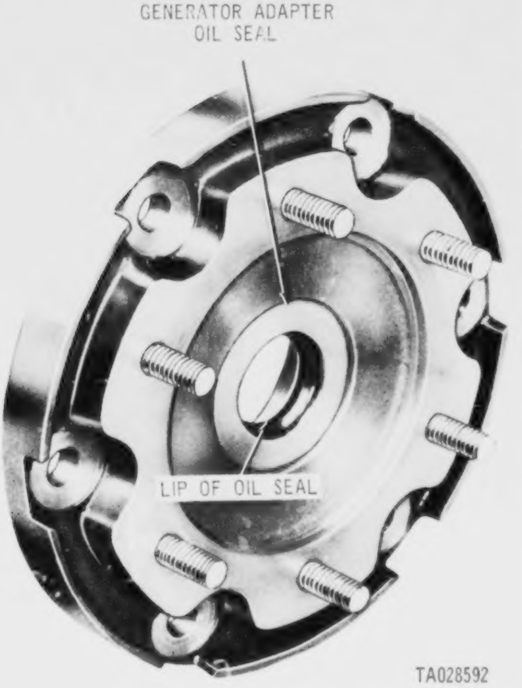


Figure 3-164. Removing generator adapter oil seal, model AVDS-1790-2D and AVDS-1790-2DR engines.

(b) Press generator drive gearshaft (fig. 3-165) from front ball bearing using a suitable arbor press. Press gearshaft from rear ball bearing in the same manner.

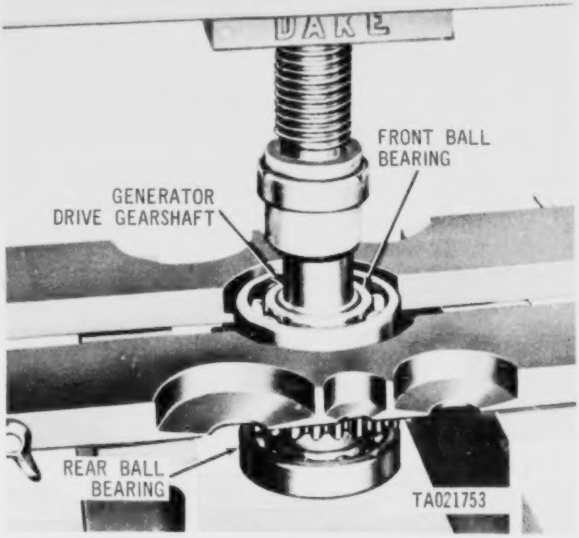


Figure 3-165. Pressing generator drive gearshaft from ball bearing, model AVDS-1790-2D and AVDS-1790-2DR engines.

(2) *Cleaning, inspection, and repair.*

(a) Refer to paragraphs 3-36 through 3-38.

(b) Inspect generator drive gearshaft, oil seal, bearings and adapter against limits specified in the repair standards (table 3-5). Replace parts not meeting these requirements.

Table 3-5. Generator Drive Repair Standards, Models AVDS-1790-2D and AVDS-1790-2DR

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Generator drive gearshaft, oil seal and bearings	3-167	x	Outside diameter of bearings on generator drive gearshaft	2.8341	2.8346	*
	3-167	y	Inside diameter of bearing bore in adapter	2.8346	2.8353	2.8356
	3-167	x-y	Fit of bearing in adapter	0.0000	0.0012L	0.0015L
	3-167	z	Inside diameter of bearing bore in crankcase liner.	2.8346	2.8353	2.8356
	3-167	x-z	Fit of bearing in crankcase	0.0000	0.0012L	0.0015L
	3-167	aa	Outside diameter of bearing hubs on gearshaft	1.3781	1.3785	1.3779
	3-167	bb	Inside diameter of bearings	1.3775	1.3780	*
	3-167	bb-aa	Fit of bearings on gearshaft	0.0001T	0.0010T	0.0001L
	3-167	cc	Outside diameter of oil seal	2.2520	2.2560	*
	3-167	dd	Inside diameter of oil seal bore in adapter	2.2490	2.2510	*
	3-167	cc-dd	Fit of oil seal in adapter	0.0010T	0.0070T	*

Refer to paragraph 3-37*c* for explanation of symbols.

best copy available

Table 3-6. Generator Adapter Stud Identification, Models AVDS-1790-2D and AVDS-1790-2DR

Fig. No.	Ref. No.	Setting Height	No. Req'd	Stud Size and Length
3-167	37	7/8	6	3/8-16 (15/64) x 3/8-24 (5/8) x 13/32

(3) *Assembly.*

(*a*) Coat ball bearings with engine oil and press front ball bearing (fig. 3-165) and rear ball bearing on gearshaft.

(*b*) Press oil seal (fig. 3-164) into adapter until seal is tight against seal flange in adapter.

NOTE

The side of the seal with the trade mark and part number must be toward the stud side of the adapter. The lip of the seal must be directed toward the side opposite the studs.

3-52. Generator and Starter Idler Gears

a. Disassembly. Remove retaining ring (fig. 3-166), securing ball bearing in generator idler gear and press ball bearing from gear. Disassemble the starter idler gear in a similar manner.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38.

(1) Inspect starter idler gear and bearing against limits specified in repair standards (table 3-7). Replace parts not meeting these requirements.

(2) Inspect generator idler gear and bearing against limits specified in repair standards (table 3-7). Replace parts not meeting these requirements.

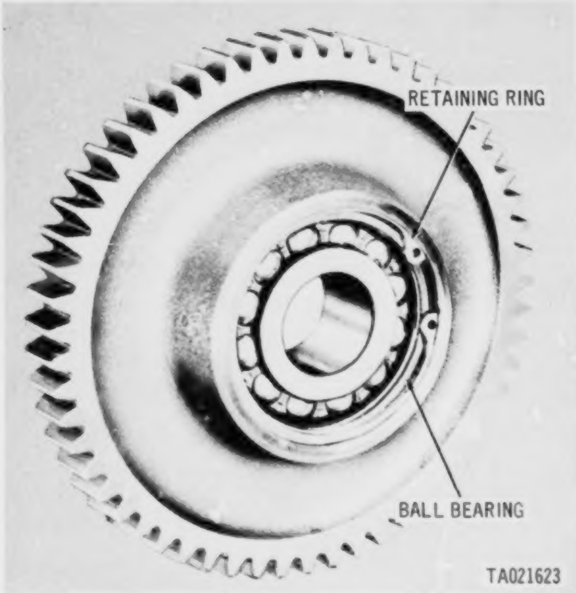


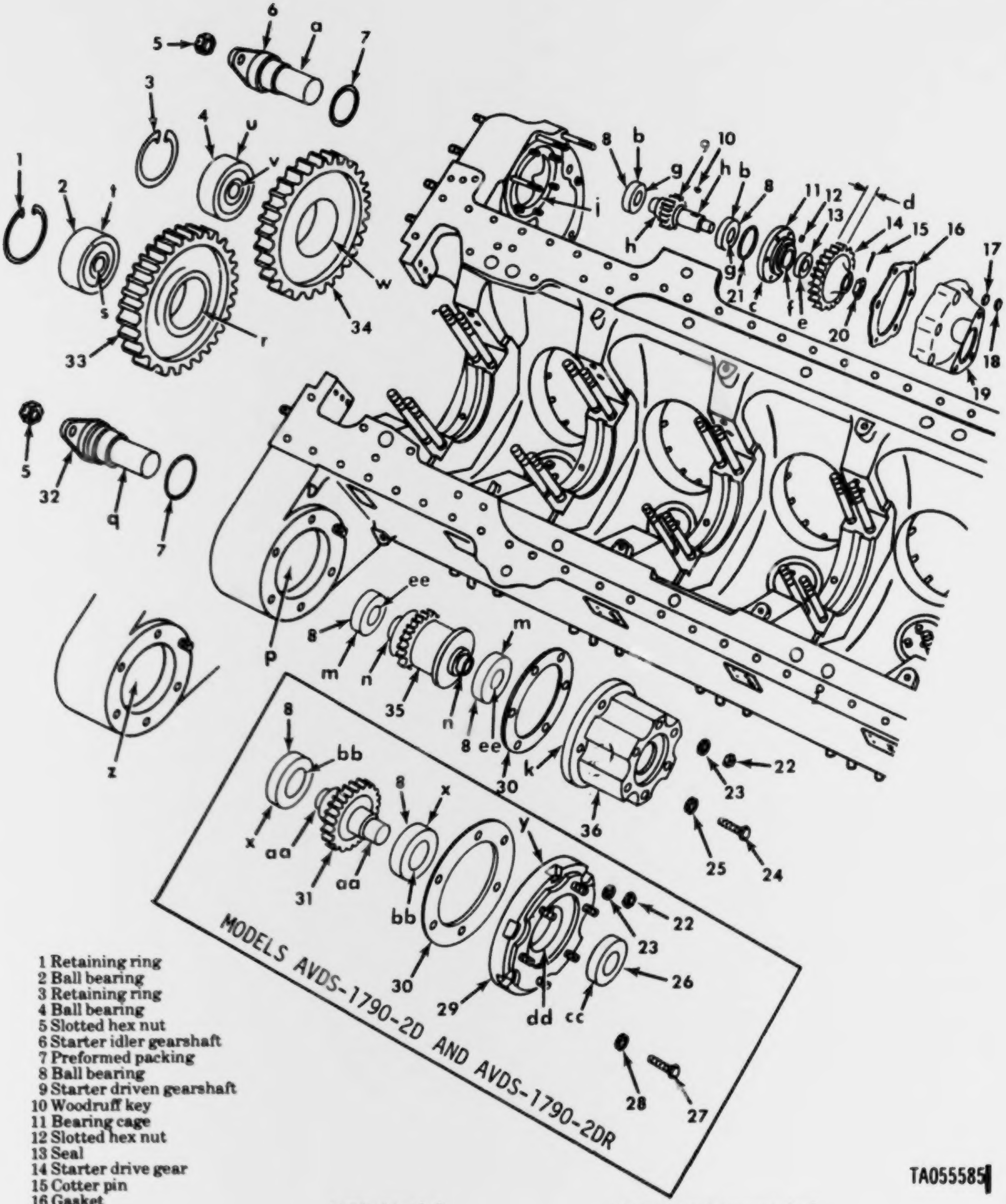
Figure 3-166. Removing generator idler gear retaining ring and ball bearing.

Table 3-7. Generator and Starter Idler Gears Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Generator idler gear with bearings	3-167	r	Inside diameter of bearing bore in generator idler gear	2.8334	2.8346	2.8348
	3-167	t	Outside diameter of bearing	2.8341	2.8346	*
Starter driven idler gear with bearings	3-167	t-r	Fit of bearing in gear	0.0005L	0.0012T	0.0007L
	3-167	q	Outside diameter of idler gearshaft	1.1804	1.1808	1.1802
	3-167	s	Inside diameter of bearing	1.1807	1.1811	*
	3-167	s-q	Fit of bearing on idler gearshaft	0.0001T	0.0007L	0.0009L
	3-167	w	Inside diameter of bearing bore in idler gear	3.5419	3.5433	3.5440
	3-167	u	Outside diameter of bearing	3.5427	3.5433	*
	3-167	u-w	Fit of bearing in gear	0.0006L	0.0014T	0.0013L
	3-167	a	Outside diameter of idler gearshaft	1.1804	1.1808	1.1802
	3-167	v	Inside diameter of bearing	1.1807	1.1811	*
	3-167	v-a	Fit of bearing on idler gearshaft	0.0001T	0.0007L	0.0009L

Refer to paragraph 3-37*c* for explanation of symbols.

c. Assembly. Coat ball bearing (fig. 3-168) with engine oil and position bearing in bearing bore of generator idler gear. Carefully press bearing into gear until bearing seats against flange in gear. Secure bearing in gear with retaining ring (fig. 3-166). Install the starter idler gear bearing in a similar manner.



1 Retaining ring
2 Ball bearing
3 Retaining ring
4 Ball bearing
5 Slotted hex nut
6 Starter idler gearshaft
7 Preformed packing
8 Ball bearing
9 Starter driven gearshaft
10 Woodruff key
11 Bearing cage
12 Slotted hex nut
13 Seal
14 Starter drive gear
15 Cotter pin
16 Gasket
17 Flat washer
18 Self-locking nut
19 Starter adapter
20 Slotted hex nut
21 Preformed packing
22 Self-locking hex nut
23 Flat washer
24 Machine bolt
25 Lockwasher
26 Oil seal
27 Machine bolt
28 Lockwasher
29 Generator adapter
30 Gasket
31 Generator drive gearshaft
32 Generator idler gearshaft
33 Generator idler spur gear
34 Starter idler spur gear
35 Generator drive gearshaft
36 Generator adapter

Figure 3-167. Generator and starter idler and driven gears and shafts – exploded view.

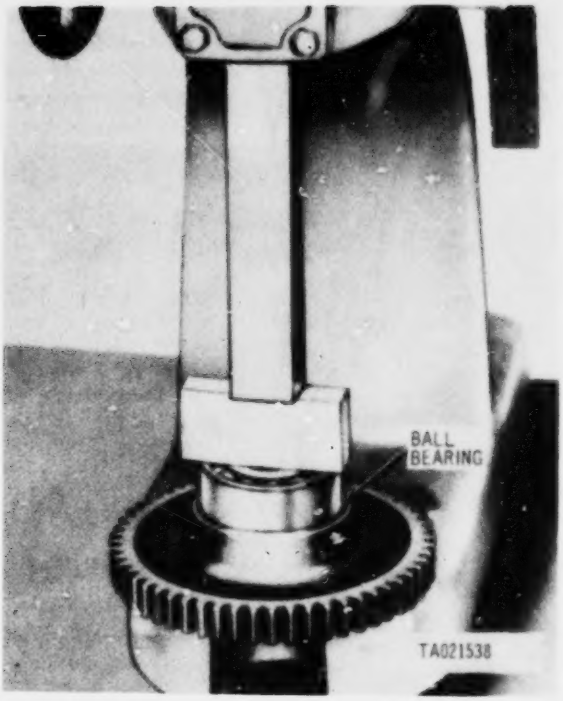


Figure 3-168. Pressing ball bearing into generator idler gear.

Section VI. REPAIR OF CONNECTING ROD, CRANKSHAFT, AND ASSOCIATED PARTS

3-53. General

This section covers the repair of the connecting rods, crankshaft, and crankshaft oil seal and retaining plugs. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedures.

3-54. Disassembly

a. Remove 24 connecting rod cap bolt self-locking nuts (fig. 3-169), attaching rod caps to connecting rods. Remove rod caps, bearings, and connecting rods from crankshaft.

NOTE

Do not use a scriber or other sharp instrument for marking connecting rod bearing halves. After bearings are removed, reassemble connecting rods and caps as they are matched sets and must be kept together for inspection and assembly. Care must be exercised in handing of the connecting rods to avoid nicks and scratches which act as stress risers and can lead to premature failure.

NOTE

For location identification, connecting rods and caps are stamped with a location number (fig. 3-170) on the side of one of the bosses. For example, "1R" would identify connecting rod and cap for No. 1 cylinder on the right bank. Mark the bearings with a grease pencil or suitable marker to indicate their locations; for example, the connecting rod bearing half for cylinder "1R" should be marked "1RR" and the bearing cap half for the same cylinder should be marked "1RC". If subsequent inspection indicates the bearings are reuseable, they must be reassembled in their original positions. If the connecting rod or cap markings are obliterated, restamp connecting rods and caps so that they can be installed in their original positions. In addition, the

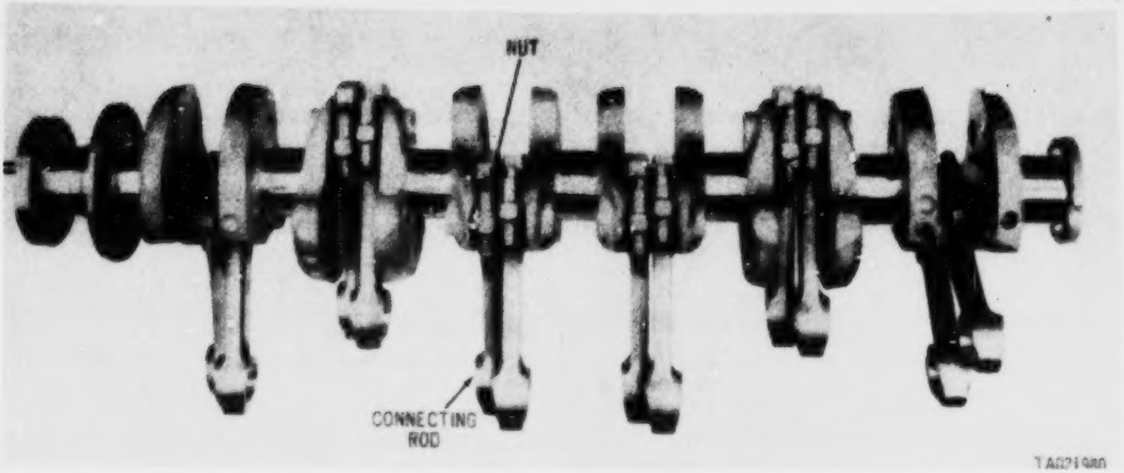

NUT
CONNECTING ROD
TA021980

Figure 3-169. Removing or installing connecting rod assemblies.

connecting rod and cap, which are a matched assembly, are marked with identifying serial numbers. The identifying serial numbers are located on the side opposite the cylinder location numbers. The rod and cap must be kept as a matched assembly, as parts are not interchangeable.

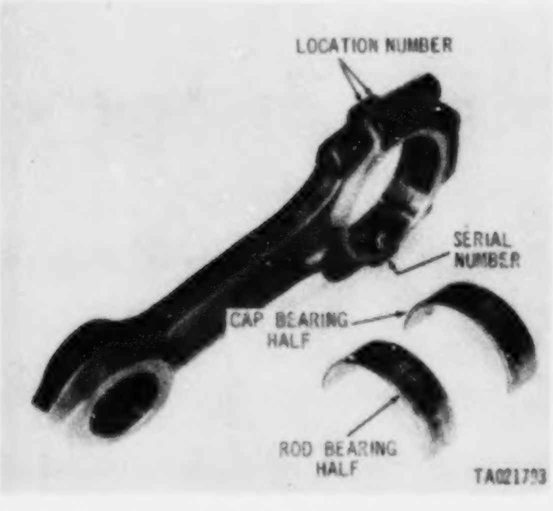

LOCATION NUMBER
SERIAL NUMBER
CAP BEARING HALF
ROD BEARING HALF
TA021793

Figure 3-170. Connecting rod and bearing location number.

b. Separate the retaining spring (fig. 3-171), from retaining lip of oil seal. Disengage the ends of the spring at its parting line with half turn as shown. Separate seal at split line and remove from the crankshaft. Discard seal and spring.

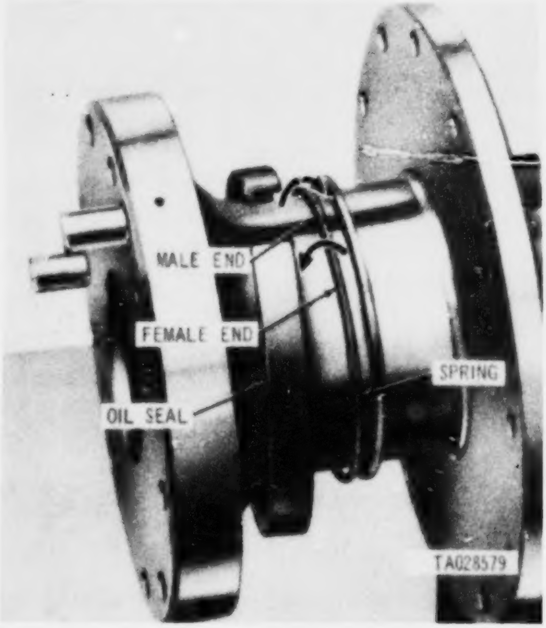

MALE END
FEMALE END
SPRING
OIL SEAL
TA028579

Figure 3-171. Removing or installing crankshaft oil seal.

c. Remove six cotter pins and remove six bolts and slotted nuts securing retaining plugs (fig. 3-172) in crankshaft connecting rod journals. Remove twelve retaining plugs from crankshaft connecting rod journals.

NOTE

Do not remove dowel pins (19, fig. 3-174) and straight pins (25) from crankshaft unless inspection (para 3-56) indicates replacement is necessary. Dowel pins in flywheel flange end are secured with setscrews.

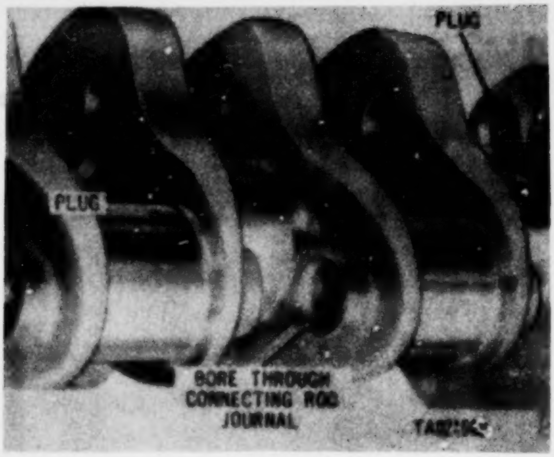


Figure 3-172. Removing or installing crankshaft oil retaining plugs.

3-55. Cleaning

Refer to paragraph 3-36. Clean crankshaft oil passages with compressed air and brass wire probes.

NOTE

Care must be taken not to destroy or remove main and connecting rod bearing location markings.

3-56. Inspection

a. Crankshaft.

(1) Inspect crankshaft for cracks with a magnifying glass (five power magnification minimum) and a strong light. Pay particular attention to areas around crankshaft oil holes and fillets adjacent to the crankshaft counter weights.

(2) Inspect connecting rod journal radii of crankshaft for evidence of specific points of wear or damage that would indicate a bent or twisted connecting rod.

(3) Check diameters of main bearing and connecting rod journals against limits specified in repair standards (table 3-8). Check runout of crankshaft by supporting end journals in "V" blocks and measuring runout at center journals with a dial indicator. Maximum allowable runout is 0.025 inch at No. 4 journal.

(4) Inspect journals for nicks, burs, grooves, scratches, galling, scuffing, or discoloration. Mark minor defect areas for future repair.

(5) Check dowel pins and straight pins for tightness in the crankshaft flanges. Check pins against limits specified in the repair standards (table 3-8).

b. Connecting Rods and Bearings.

(1) *Bearings.* Inspect connecting rod bearing halves (fig. 3-170) in the same manner as described for main sleeve bearings (para 3-45*c*). Apply a thin coating of Prussian blue, Part No. MIL-P-30501, to the backs of the connecting rod bearings and install in their respective connecting rods and caps according to the location markings (fig. 3-170). Assemble rod and cap, and torque tighten to 1250-1300 pound-inches. Check bearing inside diameter, using a dial bore indicator as shown in figure 3-173, against the limits specified in the repair standards (table 3-8), and for contact as shown by Prussian blue, transfer in the same manner in which the main sleeve bearings were checked (para 3-45*d*). Replace any bearing that does not make at least 75 percent contact.

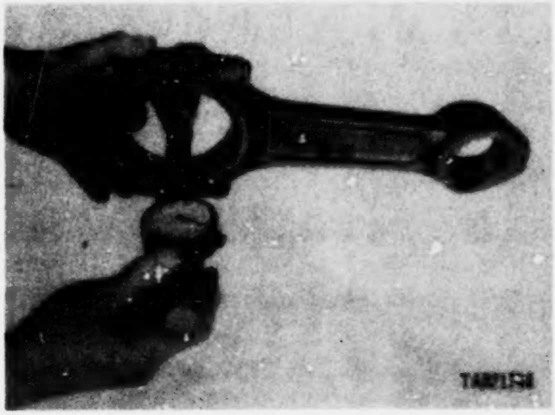
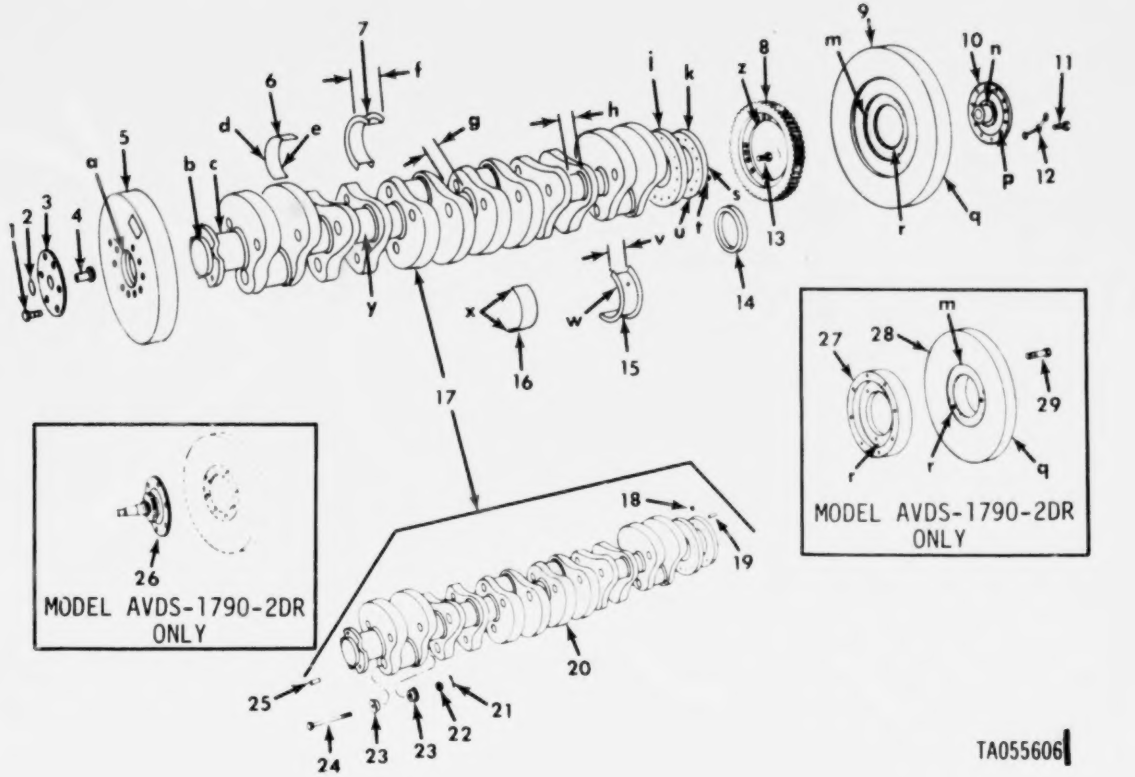


Figure 3-173. Checking connecting rod bearing bore using dial bore indicator.



1 Machine bolt
2 Retaining ring
3 Damper plate
4 Spur gear (coupling)
5 Torsional vibration damper
6 Bearing sleeve
7 Bearing sleeve
8 Spur gear
9 Flywheel
10 Spur gear
11 Machine bolt
12 Lock plate
13 Machine bolt
14 Oil seal
15 Bearing sleeve
16 Bearing sleeve
17 Engine crankshaft assembly
18 Set screw
19 Grooved dowel pin
20 Crankshaft
21 Cotter pin
22 Slotted hex nut
23 Crankpin plug
24 Machine bolt
25 Pin
26 Power takeoff spur gearshaft (Model AVDS-1790-2DR only)
27 Flywheel adapter (Model AVDS-1790-2DR only)
28 Engine flywheel (Model AVDS-1790-2DR only)
29 Machine bolt (Model AVDS-1790-2DR only)

Figure 3-174. Crankshaft assembly, flywheel, damper, bearings and associated parts – exploded view.

(2) *Connecting rod assembly.*

(a) Check connecting rod bearing bore with a bore dial indicator against limits specified in repair standards (table 3-8).

(b) Check rods for cracks and for twisted or bent condition. Bent or twisted connecting rods must be replaced. Under no circumstances should connecting rods be straightened. Destroy any rod found damaged to insure it will not be reused in an engine.

(c) Check dimension between centerline of small and large end bores (fig. 3-175). This dimension must be 10.998 to 11.002 inches. Destroy any rod that does not meet this limit to insure it will not be reused in an engine.

(d) Inspect piston pin sleeve bearing for pitting, galling, scoring, or discoloration. Mark damaged bearings for replacement.

Table 3-8. Connecting Rods, Crankshaft and Associated Parts Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Crankshaft	3-174	k	Outside diameter of flywheel hub on crankshaft	7.9980	7.9990	7.9970
	3-174	m	Inside diameter of crankshaft pilot bore in flywheel	8.0000	8.0010	8.0020
	3-174	m-k	Fit of flywheel on crankshaft	0.0010L	0.0030L	0.0050L
	3-174	u	Inside diameter of dowel pin holes in crankshaft hub, flywheel and gearshaft			
			STD	0.6245	0.6255	*

Table 3-8. Connecting Rods, Crankshaft and Associated Parts Repair Standards – Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
			0.005 oversize	0.6295	0.6305	*
			0.010 oversize	0.6345	0.6355	*
	3-174	t	Outside diameter of dowel pin			
			STD	0.6255	0.6257	*
			0.005 oversize	0.6305	0.6307	*
			0.010 oversize	0.6355	0.6357	*
	3-174	t-u	Fit of dowel pin in crankshaft hub			
			STD	0.0000	0.0012T	*
			0.005 oversize	0.0000	0.0012T	*
			0.010 oversize	0.0000	0.0012T	*
	3-174	r	Inside diameter of dowel pin holes in flywheel or flywheel adapter			
			STD	0.6262	0.6272	*
			0.005 oversize	0.6312	0.6322	*
			0.010 oversize	0.6362	0.6372	
	3-174	t	Outsize diameter of dowel pin in crankshaft			
			STD	0.6255	0.6257	*
			0.005 oversize	0.6305	0.6307	*
			0.010 oversize	0.6355	0.6357	*
	3-174	t-r	Fit of dowel pin in flywheel or flywheel adapter			
			STD	0.0005L	0.0012L	*
			0.005 oversize	0.0005L	0.0012L	*
			0.010 oversize	0.0005L	0.0012L	*
	3-174	p	Inside diameter of dowel pin hole in transmission drive gearshaft			
			STD	0.6262	0.6272	*
			0.005 oversize	0.6312	0.6322	*
			0.010 oversize	0.6362	0.6372	*
Transmission gearshaft	3-174	t	Outside diameter of dowel pin in crankshaft			
			STD	0.6255	0.6257	*
			0.005 oversize	0.6305	0.6307	*
			0.010 oversize	0.6355	0.6357	*
	3-174	t-p	Fit of dowel pin in transmission drive gearshaft			
			STD	0.0005L	0.0012L	*
			0.005 oversize	0.0005L	0.0012L	*
			0.010 oversize	0.0005L	0.0012L	*
Transmission **gearshaft**	3-174	s	Inside diameter of transmission accessory drive gearshaft pilot bore in crankshaft	2.8338	2.8346	2.8350
Crankshaft	3-174	n	Outside diameter of hub on transmission accessory drive gearshaft	2.8320	2.8330	2.8315
	3-174	n-s	Fit of transmission accessory drive gearshaft in crankshaft	0.0008L	0.0026L	0.0035L
	3-174	a	Inside diameter of crankshaft pilot bore in damper	4.2515	4.2525	4.2535
	3-174	b	Outside diameter of damper hub on crankshaft	4.2490	4.2510	4.2475
	3-174	a-b	Fit of damper on crankshaft	0.0005L	0.0035L	0.0060L
	3-174	c	Outside diameter of main bearing journals on crankshaft			
			STD	4.2495	4.2505	4.2485
			0.003 undersize	4.2465	4.2475	4.2455
			0.010 undersize	4.2395	4.2405	4.2385
	3-174	c-d	Fit (oil clearance) of bearings on journals (refer to table 3-1)	0.0040L	0.0080L	0.0100L
	3-174	y	Outside diameter of connecting rod journals on crankshaft			
			STD	3.7495	3.7505	3.7485
			0.003 undersize	3.7465	3.7475	3.7455
			0.010 undersize	3.7395	3.7405	3.7385
	3-174	z	Inside diameter of crankshaft pilot bore in accessory drive gear	9.7500	9.7520	9.7530
	3-174	j	Outside diameter of accessory drive gear mounting flange on crankshaft	9.7480	9.7500	9.7470
	3-174	z-j	Fit of accessory drive gear on crankshaft	0.0000	0.0040L	0.0060L
	3-174	g	Inside width of main thrust crankshaft journal	2.4990	2.5010	2.5030
	3-174	v-g	Fit (crankshaft end play) of thrust bearing in journal (refer to table 3-1)	0.0110L	0.0150L	0.0190L

See foot note at end of table.

Table 3-8. Connecting Rods, Crankshaft and Associated Parts Repair Standards – Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
	3-174	h	Inside width of connecting rod journal of crankshaft	3.1470	3.1510	3.1520
Connecting rod, bearings, and bolts	3-183	c	Thickness of bearing at center			
			STD	0.1703	0.1708	0.1698
			0.003 undersize	0.1713	0.1718	0.1708
			0.010 undersize	0.1748	0.1753	0.1743
	3-183	x	Thickness of bearings at ends (to be 0.0003 to 0.0006 less than "c")			
	3-183	aa	Inside diameter of bearing at proper torque tightness			
			STD	3.7546	3.7568	3.7573Ref
			0.003 undersize	3.7516	3.7538	3.7543Ref
			0.010 undersize	3.7446	3.7468	3.7473Ref
	3-174	y	Oil clearance between bearing and journal	0.0041L	0.0073L	0.0088L
	3-183	z				
	3-183	y	Outside width of connecting rod	1.5670	1.5690	*
Connecting rod, bearings, and bolts	3-174	h	Side clearance of (two) rods on crankshaft journal	0.0090L	0.0170L	0.0200L
	3-183		Allowable twist of connecting rods	0.0005 per in of bearing length. (NO straightening permitted)		
	3-183	a	Inside diameter of connecting rod (crankshaft end) at proper torque tightness	4.0941	4.0946	*
	3-183	e	Inside diameter of connecting rod (piston pin end)	2.2495	2.2505	*
	3-183	b	Inside diameter of bolt hole in connecting rod and cap	0.6248	0.6253	*
	3-183	d	Outside diameter of connecting rod bolt	0.6244	0.6246	*
	3-183	b-d	Fit of bolt in rod and cap	0.0002L	0.0009L	*
	3-183	v	Outside diameter of split sleeve bearing must be press fit in bore. Burnish to seat sleeve bearing prior to finish diameter			
	3-183	w	Inside diameter of bushing-type sleeve bearing	2.1275	2.1277	2.1280
	3-183	f	Outside diameter of piston pin	2.1250	2.1252	2.1248
	3-183	w-f	Fit of pin in bearing	0.0023L	0.0027L	0.0042L

Refer to paragraph 3-37*c* for explanation of symbols.

3-57. Repair

a. Crankshafts.

(1) Replace crankshafts that are deeply scratched, nicked, burred, scuffed or galled. Minor imperfections in the journals may be repaired by polishing with a crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II).

(2) Replace dowel pins (19, fig. 3-174) and straight pins (25) in crankshaft flange if pins do not fit securely in flange, or are out-of-round. Replace dowel pins which are not within limits specified in the repair standards (table 3-8).

NOTE

The headless grooved dowel pins in the flywheel end flanges are available in 0.005 and 0.010 in. oversize. Ream crankshaft flywheel mounting flange to necessary oversize dimensions and install new pins. Whenever oversize pins are used, it will be necessary to ream the flywheel and transmission drive gearshaft accordingly.

(3) Replace a cracked crankshaft or a crankshaft showing evidence of wear due to bent or twisted connecting rods.

b. Connecting Rods and Bearings.

(1) *Connecting rod bolts.*

(a) Replace bolts that do not fit snugly in rod and cap.

(b) Replace bolts that have damaged threads, galled pilot diameters, or diameters that are not within limits specified in repair standards (table 3-8).

(c) Replace bolts that are cracked, scratched or show any evidence of stretching.

(2) *Connecting rod bearings.* Replace all bearings that do not check within limits specified in repair standards (table 3-8) or when bearings do not show 75 percent contact by Prussian blue transfer after bore check.

(3) *Connecting rod assembly.* Discard connecting rods that are bent or distorted. Straightening of connecting rods is not permitted. Replace connecting rod assemblies which are not within limits specified in repair standards (table 3-8). Replace worn or damaged connecting rod bushing-type bearings using improvised tool (fig. 3-174.1). Burnish to seat bearing, then finish ream to 2.1275 to 2.1277 inches. Connecting rod bore center dimension (fig. 3-175) must be maintained.

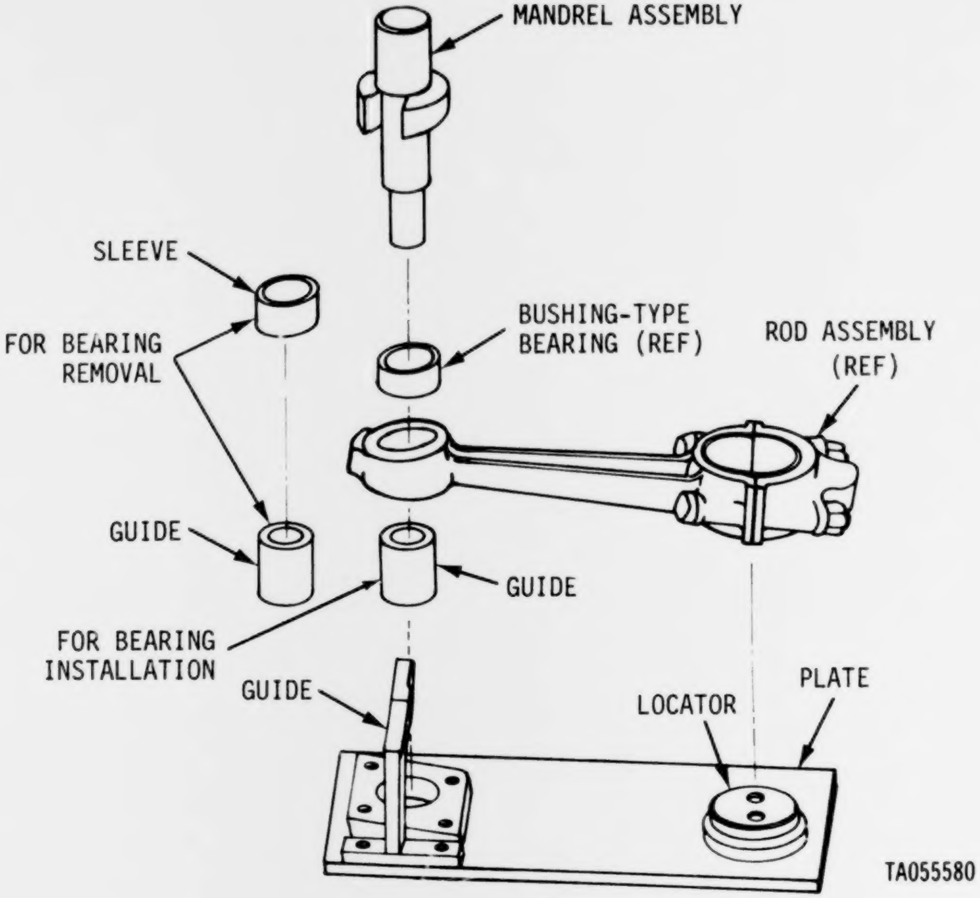


Figure 3-174.1. Removing or installing bushing-type bearing using improvised tool.

3-58. Assembly

a. Crankshaft. Position twelve retaining plugs (fig. 3-172), one in each end of bore through the six crankshaft connecting rod journals. Install six bolts and slotted nuts, securing plugs. Install six cotter pins securing slotted nuts.

b. Crankshaft Oil Seal. Apply a light coating of automotive and artillery grease (GAA), Specification MIL-G-10924, to new crankshaft oil seal (fig. 171). Install oil seal on crankshaft with closed, or flat, side toward flywheel flange. Position a new seal spring, around crankshaft as shown. Turn one end of spring one-half turn clockwise and the other end one-half turn counterclockwise. Insert male end into female end and release spring ends. Spring ends must be properly engaged. Insert the spring in the retaining groove in the oil seal.

c. Connecting Rod Assemblies.

(1) Position connecting rod bearing halves in their respective rod and caps (fig. 3-170). Install two connecting rod bolts in each connecting rod making certain each bolt is properly seated in the recess provided. Position rods on crankshaft in proper location according to their identifying number. Connecting rod Nos. 1R and 1L are assembled on the journal at the damper flange end of the crankshaft. Right bank rods (marked R) are installed on the damper flange side of journal.

NOTE

All location numbers must be visible from the oil pan side when crankshaft and rods are installed in the crankcase.

(2) Position connecting rod cap, with bearing installed, on journal and mate it with the corresponding rod. Secure rod and cap with two rod bolts and hexagon nuts. Lubricate the rod bolt threads and nut seat with a light coating of automotive and artillery grease (GAA), MIL-G-10924. Tighten both

nuts alternately to 100-150 pound-inches; then to 600-650 pound-inches, and to a final torque of 1250-1300 pound inches.

(3) Check the side clearance of each pair of connecting rods against limits specified in repair standards (table 3-8), using a feeler gage as shown in figure 3-176. Disassemble and replace connecting rods and bearings as necessary to obtain the proper clearance.

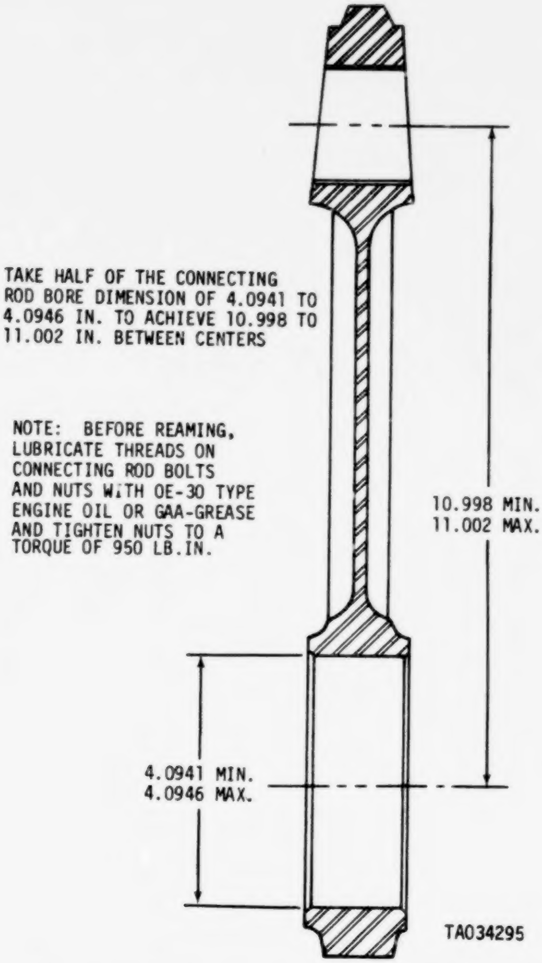

TAKE HALF OF THE CONNECTING ROD BORE DIMENSION OF 4.0941 TO 4.0946 IN. TO ACHIEVE 10.998 TO 11.002 IN. BETWEEN CENTERS
NOTE: BEFORE REAMING, LUBRICATE THREADS ON CONNECTING ROD BOLTS AND NUTS WITH OE-30 TYPE ENGINE OIL OR GAA-GREASE AND TIGHTEN NUTS TO A TORQUE OF 950 LB.IN.
10.998 MIN.
11.002 MAX.
4.0941 MIN.
4.0946 MAX.
TA034295

Figure 3-175. Connecting rod bore center dimensions.

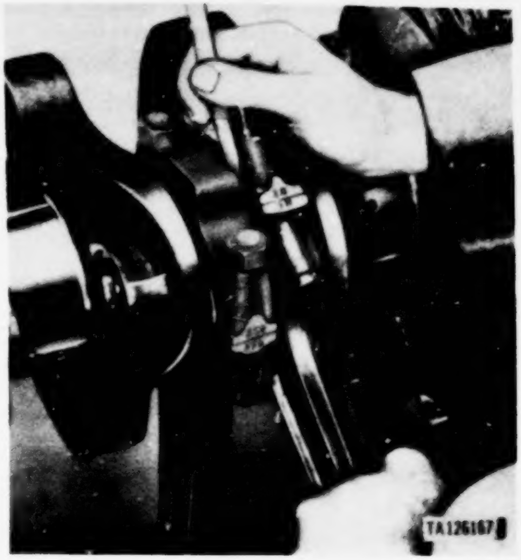


Figure 3-176. Checking connecting rod side clearance.

Section VII. REPAIR OF TORSIONAL VIBRATION DAMPER, FLYWHEEL, FLYWHEEL ADAPTER, ACCESSORY DRIVE GEAR, AND TRANSMISSION DRIVE GEARSHAFT

3-59. General

This section covers the cleaning, inspection, and repair of the torsional vibration damper, flywheel, flywheel adapter, accessory drive gear, and transmission drive gearshaft. Repair standards of the individual components follow the inspection procedures.

3-60. Cleaning and Inspection

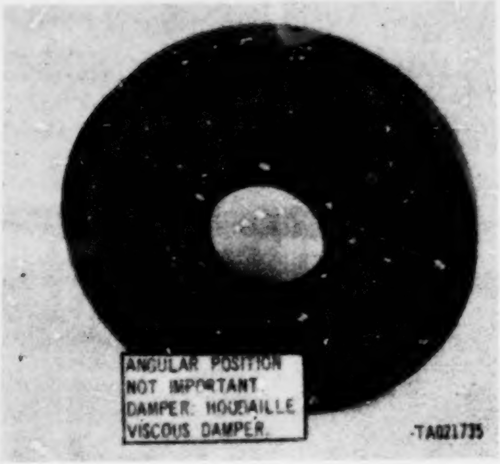
a. Cleaning. Refer to paragraph 3-36.

b. Inspection. Refer to paragraph 3-37.

(1) *Torsional vibration damper.* Inspect torsional vibration damper (5, fig. 3-174) for dents or distortion on the outer surfaces. Check for evidence of leaking. Name and warning data must be legible (figs. 3-177 and 3-178).

(2) *Flywheel.* Inspect flywheel (9 or 28, fig. 3-174) for elongated dowel pin holes. Mark oversize or out-of-round dowel pin holes for repair. Inspect flywheel against limits specified in repair standards (table 3-9). Replace flywheels not meeting these requirements.

(2.1) *Flywheel adapter.* Inspect flywheel adapter (27, fig. 3-174) for elongated dowel pin holes or loose dowel pin. Inspect flywheel adapter against limits specified in repair standards (table 3-9). Re-



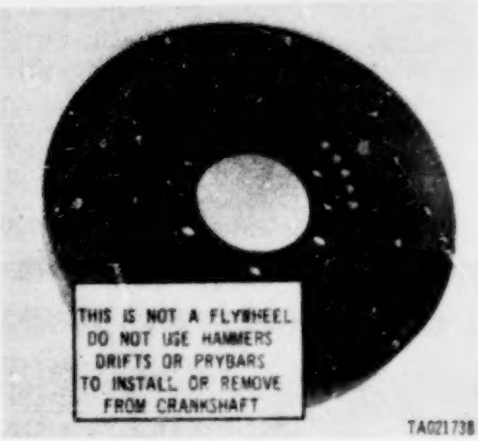


Figure 3-178. Torsional vibration damper warning data.

place flywheel adapters not meeting these standards.

(3) *Transmission drive gearshaft.* Inspect spur gear (10, fig. 3-174) for oversize or out-of-round dowel pin holes. Mark dowel pin holes for repair. Inspect transmission drive gearshaft against limits specified in repair standards (table 3-9). Replace gearshaft if it does not meet these requirements.

(4) *Accessory drive spur gear.* Inspect accessory drive spur gear (8, fig. 3-174) against limits specified in repair standards (table 3-9). Replace accessory drive gear if it does not meet these requirements.

Table 3-9. Torsional Vibration Damper, Flywheel, Accessory Drive Gear, and Transmission Drive Gearshaft Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Torsional vibration damper	3-174	a	Inside diameter of crankshaft pilot bore in damper	4.2515	4.2525	4.2535
	3-174	b	Outside diameter of damper hub on crankshaft	4.2490	4.2510	4.2475
	3-174	a-b	Fit of damper on crankshaft	0.0005L	0.0035L	0.0060L
Flywheel	3-174	k	Outside diameter of flywheel hub on crankshaft	7.9980	7.9990	7.9970
	3-174	m	Inside diameter of crankshaft pilot bore in flywheel	8.0000	8.0010	8.0020
	3-174	k-m	Fit of flywheel on crankshaft	0.0010L	0.0030L	0.0050L
	3-174	q	Flywheel runout	0.0000	0.0150	0.0150
	3-174	r	Inside diameter of dowel pin holes in flywheel, or flywheel adapter			
	3-174	r	Inside diameter of dowel pin holes in flywheel			
			STD	0.6262	0.6272	*
			0.005 oversize	0.6312	0.6322	*
			0.010 oversize	0.6362	0.6372	
Flywheel	3-174	t	Outside diameter of dowel pin in crankshaft			
			STD	0.6255	0.6257	*
			0.005 oversize	0.6305	0.6307	*
			0.010 oversize	0.6355	0.6357	*
	3-174	t-r	Fit of dowel in flywheel, or flywheel adapter			
	3-174	t-r	Fit of dowel pin in flywheel			
			STD	0.0005L	0.0012L	*
			0.005 oversize	0.0005L	0.0012L	*
			0.010 oversize	0.0005L	0.0012L	*
Accessory drive	3-174	j	Outside diameter of accessory drive gear mounting flange on crankshaft	9.7480	9.7500	9.7470
	3-174	z	Inside diameter of crankshaft pilot bore in accessory drive gear	9.7500	9.7520	9.7530
	3-174	z-j	Fit of accessory drive gear on crankshaft	0.0000	0.0040L	0.0060L

See foot note at end of table.

Table 3-9. Torsional Vibration Damper, Flywheel, Accessory Drive Gear, and Transmission Drive Gearshaft Repair Standards – Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Transmission gearshaft	3-174	n	Outside diameter of hub on transmission accessory drive gearshaft	2.8320	2.8330	2.8315
	3-174	s	Inside diameter of transmission accessory drive gearshaft pilot bore in crankshaft	2.8338	2.8346	2.8350
	3-174	n-s	Fit of transmission accessory drive gearshaft in crankshaft	0.0008L	0.0026L	0.0035L
	3-174	p	Inside diameter of dowel pin hole in transmission drive gearshaft			
	3-174	p	Inside diameter of dowel pin hole in transmission drive gearshaft			
			STD	0.6262	0.6272	*
			0.005 oversize	0.6312	0.6322	*
			0.010 oversize	0.6362	0.6372	*
	3-174	t	Outsize diameter of dowel pin in crankshaft			
			STD	0.6255	0.6257	*
			0.005 oversize	0.6305	0.6307	*
			0.010 oversize	0.6355	0.6357	*
	3-174	t-p	Fit of dowel pin in transmission drive gearshaft			
			STD	0.0005L	0.0012L	*
			0.005 oversize	0.0005L	0.0012L	*
			0.010 oversize	0.0005L	0.0012L	*

Refer to paragraph 3-37*c* for explanation of symbols.

3-61. Repair

a. General. Refer to paragraph 3-38.

b. Torsional Vibration Damper. Replace torsional vibration damper when it does not conform to limits specified in repair standards (table 3-9). Replace damper when dented or distorted or if evidence of leaking is present. Remove minor imperfections with crocus cloth dipped in dry cleaning solvent or mineral spirits paint thinner.

c. Flywheel and Transmission Drive Gearshaft. Repair elongated dowel pin holes in flywheel and gearshaft by reaming to either 0.005 or 0.010 inch oversize. Install the appropriate oversize dowel pins in the crankshaft. It will be necessary to line ream the crankshaft flange, flywheel, and transmission drive gearshaft to install the replacement oversize pins.

d. Transmission Drive Gearshaft Bushing-Type Bearing. When the gearshaft bushing-type bearing needs replacement, use a suitable arbor and an arbor press to remove bushing-type bearing as shown in figure 3-179. Press new bushing-type bearing into gearshaft using arbor press as shown in figure 3-180. Ream the bushing-type bearing from 1.3775 to 1.3780 inch after installation. When oversize dowel pins have been installed in the crankshaft, the transmission drive gearshaft dowel pin holes must be reamed in the proper oversize dimension.

e. Accessory Drive Gear. Refer to paragraph 3-38*g* for repair of accessory drive gear.

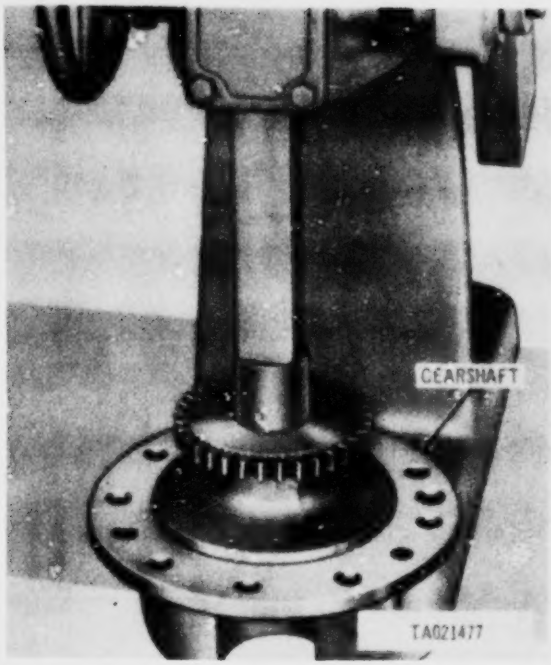


Figure 3-179. Pressing bushing-type bearing from transmission drive gearshaft, model AVDS-1790-2C and AVDS-1790-2D engines.

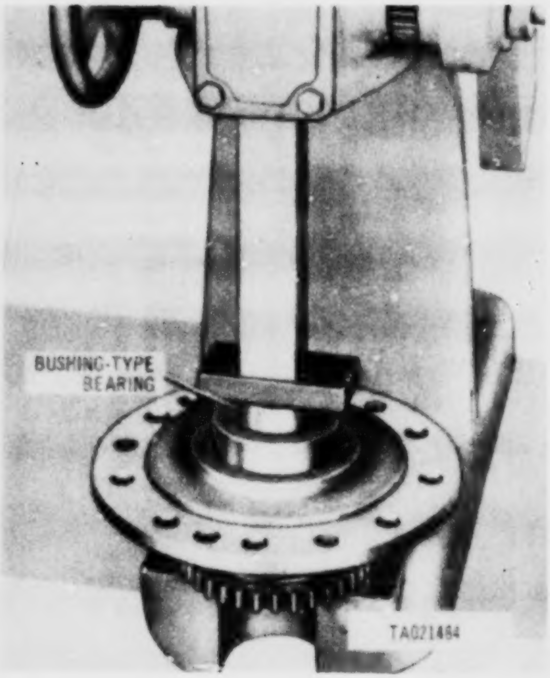


Figure 3-180. Pressing bushing-type bearing into transmission drive gearshaft, model AVDS-1790-2C and AVDS-1790-2D engines.

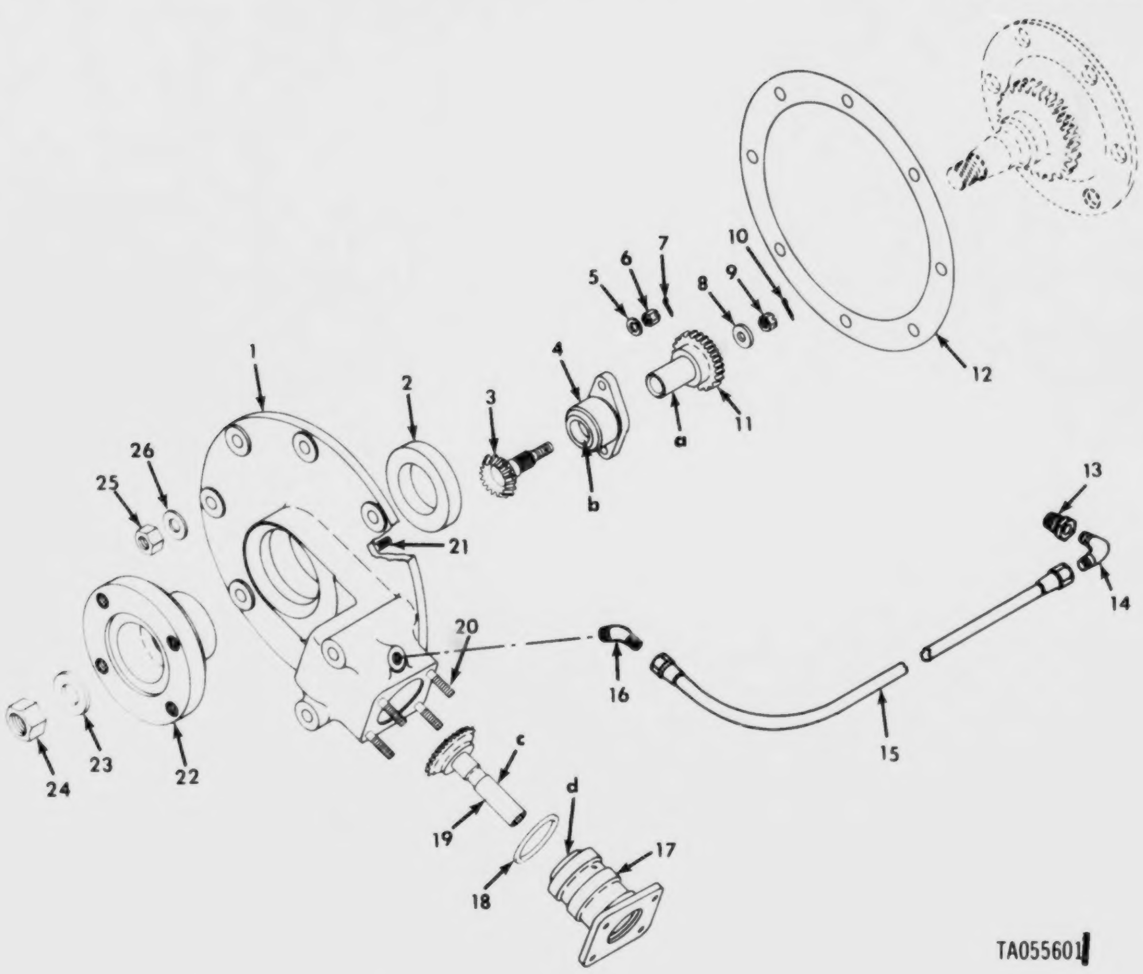
Section VII.1. REPAIR OF POWER TAKEOFF DRIVE HOUSING

3-61.1. General

This section covers the repair of the fuel pump drive housing. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedures. Stud identification information is included in the repair procedures.

3-61.2. Disassembly

a. Remove fuel pump bevel gearshaft adapter (17, fig. 3-180.1). Remove and discard preformed packing (18). Remove and discard two cotter pins (7). Remove two hexagon slotted plain nuts (6), flat washers (5) and remove fuel pump drive bevel gearshaft adapter (4).



1 Fuel pump drive housing
2 Encased plain seal
3 Bevel gearshaft
4 Fuel pump drive bevel gearshaft adapter
5 Flat washer
6 Hexagon slotted plain nut
7 Cotter pin
8 Flat washer
9 Hexagon slotted plain nut
10 Cotter pin
11 Spur gear
12 Gasket
13 Bushing
14 Pipe to tube elbow
15 Hose assembly
16 Pipe to tube elbow
17 Fuel pump bevel gearshaft adapter
18 Preformed packing
19 Bevel gearshaft
20 Plain stud
21 Plain stud
22 Shaft half coupling
23 Flat washer
24 Hexagon self-locking nut
25 Hexagon self-locking nut
26 Flat washer

Figure 3-180.1: Fuel pump drive housing and associated parts – exploded view, model AVDS-1790-2DR engine.

b. Remove and discard cotter pin (10). Remove hexagon slotted plain nut (9), flat washer (8), and separate bevel gearshaft (3) from spur gear (11). Remove pipe to tube elbow (16). Remove and discard encased plain seal (2).

3-61.3. Cleaning

Refer to paragraph 3-36.

3-61.4. Inspection and Repair

Refer to paragraphs 3-37 and 3-38. Refer to paragraph 3-38*d* and table 3-9.1 when replacing studs. Check parts against limits specified in repair standards, table 3-9.2.

Table 3-9.1. Power Takeoff Drive Housing Stud Identification

Fig. No.	Ref. No.	Setting Height	No. req'd.	Stud size and length
3-180.1	20	1-1/8	4	5/16-18(49/64) x 5/16-24(53/64 x 1-25/32
3-180.1	21	23/32	2	1/4-20(37/64) x 1/4-28(35/64) x 1-3/16

Table 3-9.2. Power Takeoff Drive Housing Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Spur gear and fuel pump drive bevel gearshaft adapter	3-180.1	a	Outside diameter of shaft on spur gear	0.8090	0.8100	0.8085
	3-180.1	b	Inside diameter of bore in fuel pump drive bevel gearshaft adapter	0.8120	0.8130	0.8145
	3-180.1	a - b	Fit of gear in adapter	0.0020L	0.0040L	0.0050L
	3-180.1	a - b	End play after assembly	0.0020	0.0050	0.0070
Bevel gearshaft and fuel pump bevel gearshaft adapter	3-180.1	c	Outside diameter of shaft on bevel gearshaft	0.7465	0.7475	0.7460
	3-180.1	d	Inside diameter of bore in fuel pump bevel gearshaft adapter	0.7495	0.7505	0.7510
	3-180.1	c - d	Fit of gearshaft in adapter	0.0020L	0.0040L	0.0050L

3-61.5. Assembly

a. Install new encased plain seal (2, fig. 3-180.1) in fuel pump drive housing (1) with lip of seal toward front of housing (bottom of counterbore). Install pipe to tube elbow (16).

b. Install spur gear (11) in fuel pump drive bevel gearshaft adapter (4). Install bevel gearshaft (3) and secure with flat washer (8), hexagon slotted plain nut (9) and new cotter pin (10). Check end play between spur gear (11) and fuel pump drive bevel gearshaft adapter (4). End play must not exceed 0.007 inch after assembly. Install fuel pump drive bevel gearshaft adapter and gears on fuel pump drive housing studs (21) and secure with two flat washers (5), hexagon slotted plain nuts (7) and new cotter pins (8).

c. Install new preformed packing (18) in groove on fuel pump bevel gearshaft adapter (17). Install bevel gearshaft (19) in fuel pump bevel gearshaft adapter (17) and install the assembly in the fuel pump drive housing (1). Check to be certain the bevel gearshafts (3 and 19) are properly meshed.

Section VIII. REPAIR OF PISTONS, RINGS, AND PISTON PINS

3-62. General

This section covers the repair of the pistons, rings, and piston pins. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedures.

3-63. Disassembly

a. Check to see if compression rings and oil control ring are free in piston grooves before removal. Mark ring grooves of sticking rings for further detailed inspection. Place jaws of remover and replacer Part No. 7950177 in the end gap of upper piston ring (fig. 3-181). Spread ring, lift out of groove, and remove from piston. Mark rings for identification showing piston number and groove location. Remove two intermediate compression rings and oil control ring in the same manner.

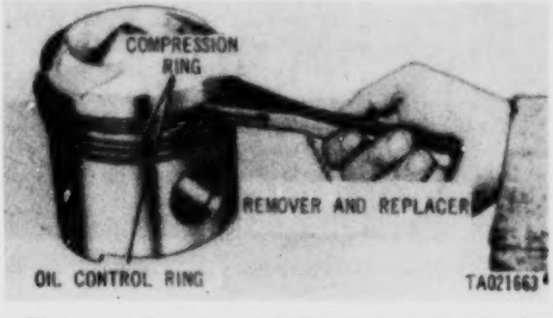


Figure 3-181. Removing or installing piston compression rings using remover and replacer.

b. Remove oil control piston ring expander spring (fig. 3-182), by separating at parting line as shown.

3-64. Cleaning

a. Clean pistons (9, fig. 3-183), piston pins (8), and piston rings (10, 11, and 12) by soaking in carbon.

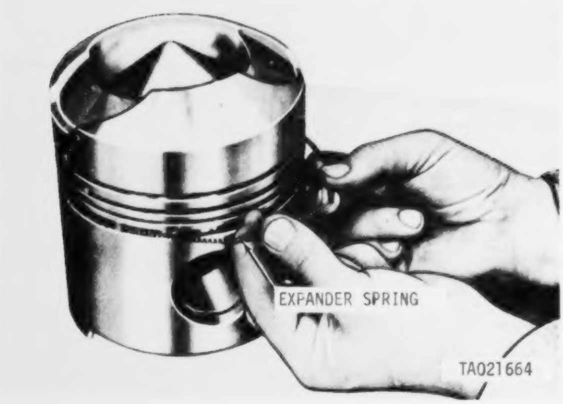


Figure 3-182. Removing or installing oil control piston ring expander spring.

removing compound. Specification MIL-C-25107. (Ord Type 1).

WARNING

Use goggles, rubber gloves, and rubber apron when cleaning parts in carbon removing compound. Provide adequate ventilation. Avoid inhalation of fumes and skin contact. If compound is splashed on skin, flush with fresh water and wash with alcohol. Alcohol containing 2 to 3 percent camphor is preferable.

b. Scrape remaining carbon deposits from piston ring grooves with a scraper or broken piston ring. Be careful not to scratch or gouge ring grooves and lands on piston. Clean oil drain holes and oil ring grooves in piston. Remove carbon from oil holes in ring grooves. Clean carbon from piston pins with crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II).

3-65. Inspection

NOTE

It is important that all pistons be the same size (oversize) and weight.

a. Inspect the top of the piston for oversize and weight code identification stamps. Refer to figure 3-182.1 for stamp locations.

NOTE

Early pistons supplied as individual spare parts were not stamped to indicate weight. To insure that all pistons used for replacement are properly matched by weight, all uncoded pistons must be weighed and code stamped before being installed in an engine. If the weight code is missing or not legible, weigh the piston and metal stamp the weight identification code at the location shown in figure 3-182.1, using 0.25 inch high characters in accordance with Table 3-9.3.

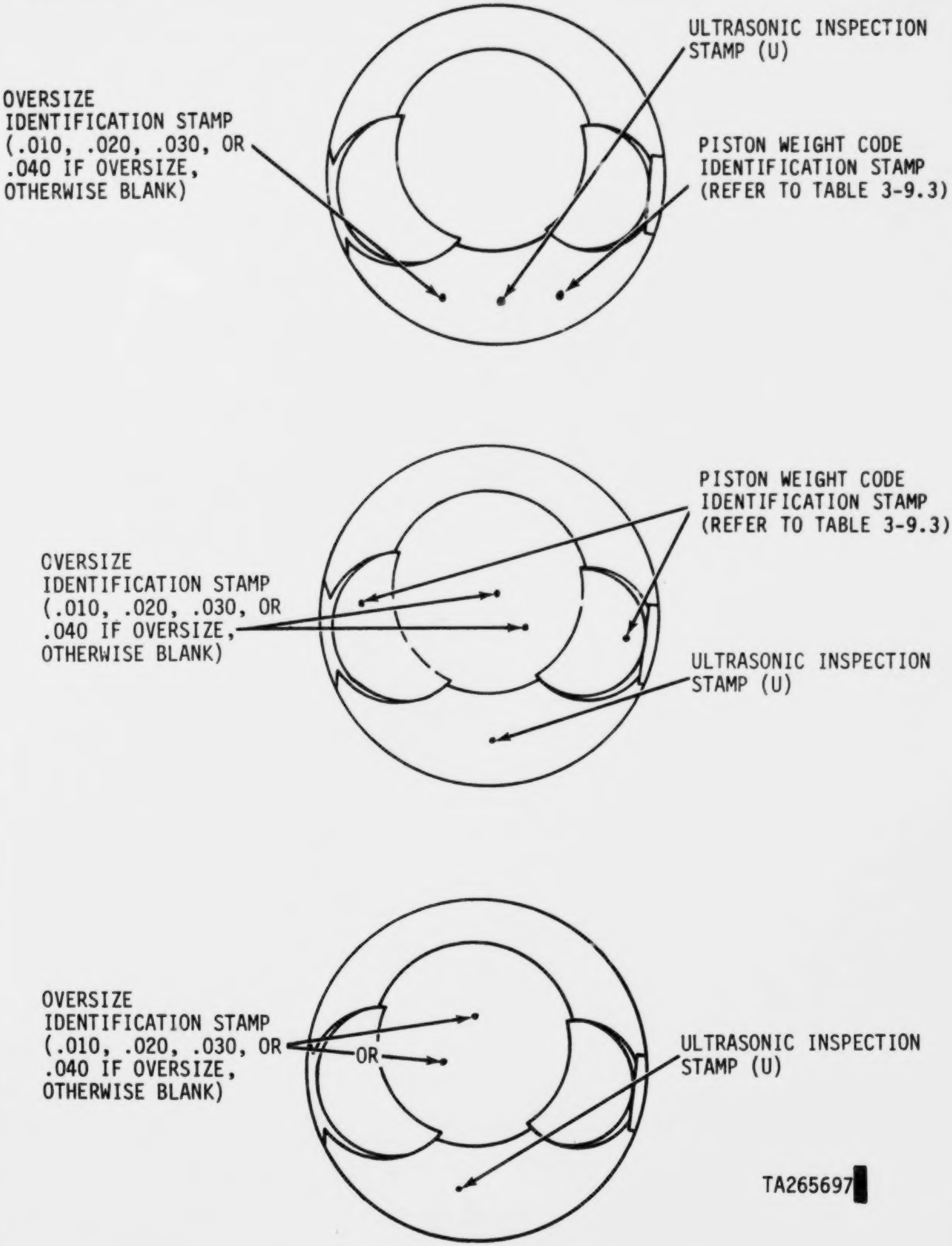
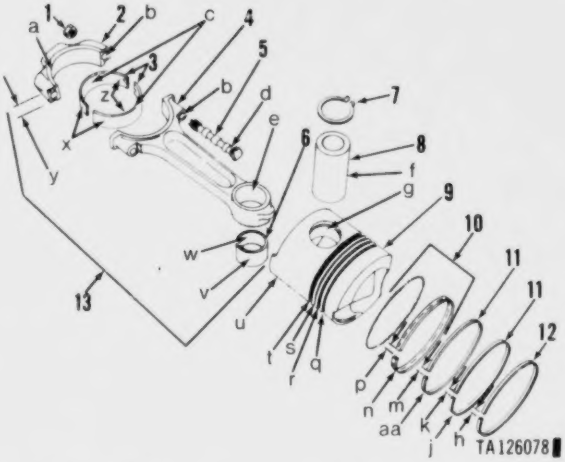

ULTRASONIC INSPECTION STAMP (U)
OVERSIZE IDENTIFICATION STAMP (.010, .020, .030, OR .040 IF OVERSIZE, OTHERWISE BLANK)
PISTON WEIGHT CODE IDENTIFICATION STAMP (REFER TO TABLE 3-9.3)
PISTON WEIGHT CODE IDENTIFICATION STAMP (REFER TO TABLE 3-9.3)
OVERSIZE IDENTIFICATION STAMP (.010, .020, .030, OR .040 IF OVERSIZE, OTHERWISE BLANK)
ULTRASONIC INSPECTION STAMP (U)
OVERSIZE IDENTIFICATION STAMP (.010, .020, .030, OR .040 IF OVERSIZE, OTHERWISE BLANK)
OR
ULTRASONIC INSPECTION STAMP (U)
TA265697

Figure 3-182.1. Oversize and weight code identification locations.

b. Inspect piston (9, fig. 3-183) for cracks, flaws or distortion. Use a magnifying glass and a strong light. Small cracks will show under the light as irregular or dark streaks. Inspect the top (tapered) ring groove using piston ring gage, part number 12254296 (fig. 3-183.1). Insert gage in top groove. If the shoulder of the gage touches the ring land, the piston must be discarded. If the piston ring gage is not available, the top groove may be checked by measuring over pins and the measurement checked against limits specified in repair standards (table 3-11). Check the second, third, and fourth ring grooves against limits specified in repair standards (table 3-11). Inspect piston for damage or broken ring lands, nicks, burs, or scratches. Inspect piston pin bores for wear, cracks, or abrasions. Replace piston if unserviceable.



1 Nut, extended washer
2 Cap, connecting rod
3 Bearing, sleeve
4 Rod, connecting
5 Bolt, connecting rod
6 Bearing, sleeve
7 Ring, piston pin retainer
8 Piston pin
9 Piston
10 Ring, piston oil control
11 Ring — piston compression
12 Ring — piston compression
13 Crankshaft connecting rod assembly

Figure 3-183. Piston, connecting rod and associated parts – exploded view.

Table 3-9.3. Piston Weight Code Identification Chart

STAMP CODE	PISTON WEIGHT LBS.	STAMP CODE	PISTON WEIGHT LBS.	STAMP CODE	PISTON WEIGHT LBS.
5	7.75 7.76 7.77	B	7.93 7.94 7.95	H	8.11 8.12 8.13
4	7.78 7.79 7.80	C	7.96 7.97 7.98	J	8.14 8.15 8.16
3	7.81 7.82 7.83	D	7.99 8.00 8.01	K	8.17 8.18 8.19
2	7.84 7.85 7.86	E	8.02 8.03 8.04	L	8.20 8.21 8.22
1	7.87 7.88 7.89	F	8.05 8.06 8.07	M	8.23 8.24 8.25
A	7.90 7.91 7.92	G	8.08 8.09 8.10		

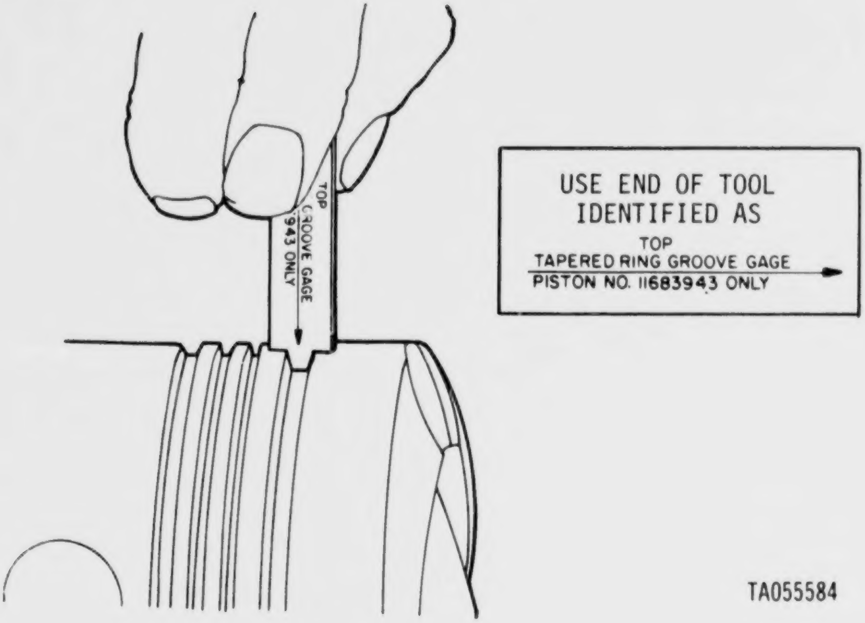


Figure 3-183.1. Checking piston top ring groove using tapered piston ring gage.

c. Inspect compression ring (11) and (12), and oil control ring (10) for scuffing, scoring, chipping, scratches or abrasions. Pay particular attention to those rings which were found to be sticking in the piston ring grooves. Install the three lower rings in their original position and check side clearance as described in (1) through (4) below.

(1) Insert remover and replacer Part No. 7950177 in end gap of ring (fig. 3-181) and install oil control ring in bottom piston ring groove. Install two intermediate compression rings in the same manner.

(2) Measure side clearance of the three bottom rings with a thickness gage as shown in figure 3-184. Mark all rings for replacement that are not within limits specified in repair standards (table 3-10). The upper compression ring (12, fig. 3-183) may be checked by measuring the diameter over roll pins or by using the tapered piston ring groove improvised tool. Excessive side clearance indicates worn rings and/or worn piston grooves. Less than normal clearance indicates probable damage or breakage at the ring land.

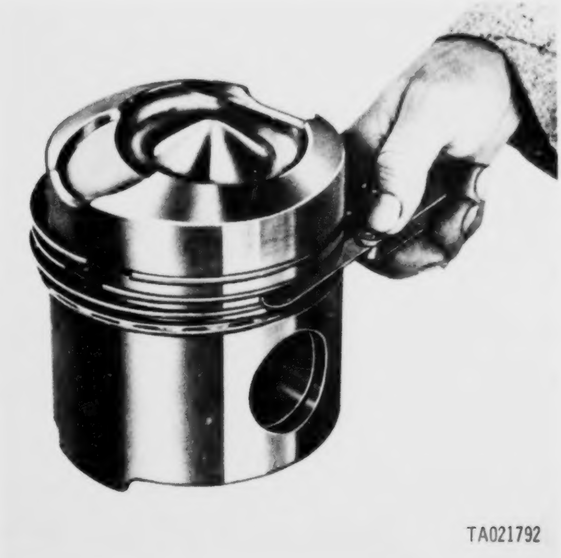
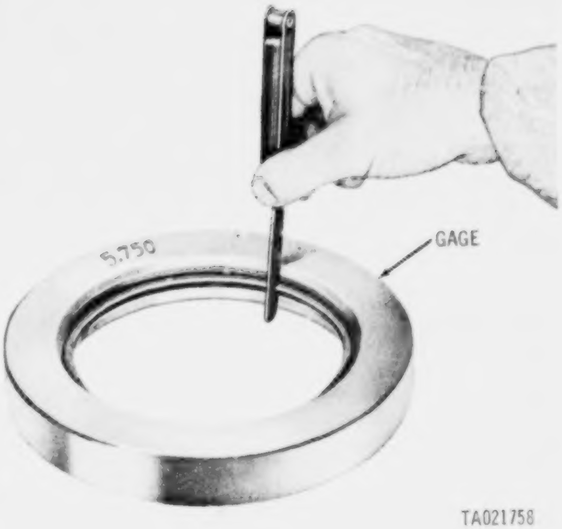


Figure 3-184. Checking piston ring side clearance.

(3) Remove piston rings from piston ((1) above). Scrape carbon from end gap and measure end gap.

(4) Place rings in the specified ring gage (table 3-10) and measure end gap of oil rings as shown in figure 3-185). Replace rings not conforming to limits specified in the repair standards (table 3-11). Ring gages are identified according to ring size. Some gages are dual purpose tools, i.e., each side for a different size ring.



TA021758

Figure 3-185. Measuring piston ring end gap using piston ring gage.

Table 3-10. Piston ring gages

Ring gage	Gage identification	Ring size identification
10912589	5.7500 and 5.7700	Standard and 0.020 in. oversize
10912589-1	5.7600 and 5.7800	0.010 and 0.030 in. oversize
10912589-2	0.7500 and 5.7900	Standard and 0.040 in. oversize

d. Inspect piston pin (8, fig. 3-183) for cracks, nicks, or wear. Check diameter of pins against limits specified in repair standards (table 3-11).

Table 3-11. Pistons, Piston Rings and Piston Pins Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Piston	3-183	u	Diameter at bottom of skirt 90 degrees to piston pin			
			STD	5.7410	5.7420	5.7380
			0.0100 oversize	5.7510	5.7520	5.7480
			0.0200 oversize	5.7610	5.7620	5.7580
			0.0300 oversize	5.7710	5.7720	5.7680
			0.0400 oversize	5.7810	5.7820	5.7780
	3-183	q	Diameter of top groove in piston (measured over 0.11547 dia. pins)			
			STD	5.7140	5.7240	5.7040
			0.0100 oversize	5.7240	5.7340	5.7140
			0.0200 oversize	5.7340	5.7440	5.7240
			0.0300 oversize	5.7440	5.7540	5.7340
			0.0400 oversize	5.7540	5.7640	5.7440

See footnote at end of table.

Table 3-11. Pistons, Piston Rings and Piston Pins Repair Standards – Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
	3.183	r	Inside width of top intermediate groove in piston	0.0990	0.1000	0.1035
	3-183	s	Inside width of lower intermediate groove in piston	0.0980	0.0990	0.1025
	3-183	t	Inside width of oil control ring groove in piston	0.1880	0.1890	0.1910
Piston	3-183	g	Inside diameter of piston pin bore in piston	2.1268	2.1270	2.1280
Piston pins	3-183	f	Outside diameter of piston pin	2.1250	2.1252	2.1248
	3-183	g-f	Fit of piston pin in piston	0.0016L	0.0020L	0.0032L
Piston rings	3-183	h	Gap clearance of top compression ring when fitted in gage	0.0250	0.0350	*
	3-183	j	Outside width of top intermediate compression ring	0.0925	0.0935	*
	3-183	r-j	Clearance between ring and piston	0.0055L	0.0075L	0.0110L
	3-183	k	Gap clearance of ring when fitted in gage	0.0250	0.0350	*
	3-183	aa	Outside width of lower compression ring	0.0925	0.0935	*
	3-183	s-aa	Clearance between ring and piston	0.0045L	0.0065L	0.0100L
	3-183	m	Gap clearance of ring when fitted in gage	0.0250	0.0350	*
	3-183	n	Outside width of oil control ring	0.1855	0.1865	*
	3-183	t-n	Clearance between ring and piston	0.0015L	0.0035L	0.0055L
	3-183	p	Gap clearance of ring when fitted in gage	0.0350	0.0450	*
	3-190	c	Cylinder bore diameter measured up 2.250 inches from bottom of cylinder skirt			
			STD	5.7510	5.7530	5.7580
			0.0100 oversize	5.7610	5.7630	5.7680
			0.0200 oversize	5.7710	5.7730	5.7780
			0.0300 oversize	5.7810	5.7830	5.7880
			0.0400 oversize	5.7910	5.7930	5.7980
	3-183 3-190	u-c	Fit of piston in cylinder bore, measured up 2.250 inches from bottom of cylinder skirt, 90 degrees to piston pin	0.0090L	0.0120L	0.200L

Refer to paragraph 3-37c for explanation of symbols.

3-66. Repair

a. Replace pistons which are distorted, cracked, worn, abraded, or if oil holes in the ring lands cannot be cleared, or if lands are damaged or broken. Replace pistons that are badly bured, nicked, or scratched. Remove minor burs, nicks or scratches from pistons with crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II). Replace pistons which are not within limits specified in repair standards (table 3-11).

b. Piston rings cannot be repaired. Replace rings that are scuffed, chipped, scratched, or when they show signs of abrasion. Replace rings when not within limits specified in repair standards (table 3-11). Replace oil control rings if drain holes cannot be cleared.

c. Replace all piston pins which are cracked, or have deep nicks or scratches. Remove minor nicks or scratches with crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II). Replace piston pins that are not within limits specified in repair standards (table 3-11).

3-67. Assembly

a. Check marking on rings and install the upper (tapered) compression ring and the two intermediate compression rings with the marking "TOP" or "PIP" mark toward the piston dome. Oil control rings are symmetrical and may be installed with either side up. Install all rings using remover and replacer Part No. 7950177 as shown in figure 3-181. Use care in installing rings to avoid damaging ring lands or distorting rings.

b. Install piston pin in bore of piston. The piston pin retaining rings should not be installed until the piston and cylinder are installed on the engine, paragraph 3-164*h*.

Section IX. REPAIR OF CYLINDER ASSEMBLY

3-68. General

This section covers the repair of the cylinder assembly. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedures. Stud identification information is included in the repair procedures.

3-69. Disassembly

a. Cylinder.

NOTE

The twelve rocker arm cover assemblies are machined with cylinder assemblies as matched units. The covers are stamped with matching letters and numbers (fig. 3-64) to correspond with the letter and number stamped on the cylinder. Keep covers with their respective cylinders.

(1) Place cylinder with valves, springs, and retainers on removing and inserting valve stand (fig. 3-186).

(2) Secure valve lifter assembly Part No. 8761535 (fig. 3-186) to the cylinder head with four cover bolts and flat washers.

WARNING

The valves and locks are under heavy spring tension. Exercise extreme care when removing locks, retainers and springs.

(3) Compress exhaust valve spring and upper retainer. Remove two valve locks (fig. 3-187), from the groove in valve stem. Tap valve spring retainers to free locks. Carefully loosen lifter screw to release valve springs. Remove valve lifter assembly.

(4) Remove intake valve spring upper retainer.

(5) Remove exhaust valve inner, intermediate, and outer valve springs, upper retainer and exhaust valve rotor (fig. 3-188), from valve stem. Remove intake valve springs, retainer, and seat in the same manner.

(6) Remove the cylinder from removing and inserting valve stand (fig. 3-188) making certain valves do not drop out. Replace cylinder on side and remove the intake and exhaust valves through the cylinder bore.

NOTE

Temporarily install valve rocker arm covers on cylinders with two bolts to prevent damage and mismatching of parts. Refer to figure 3-64 for cover and cylinder identification.

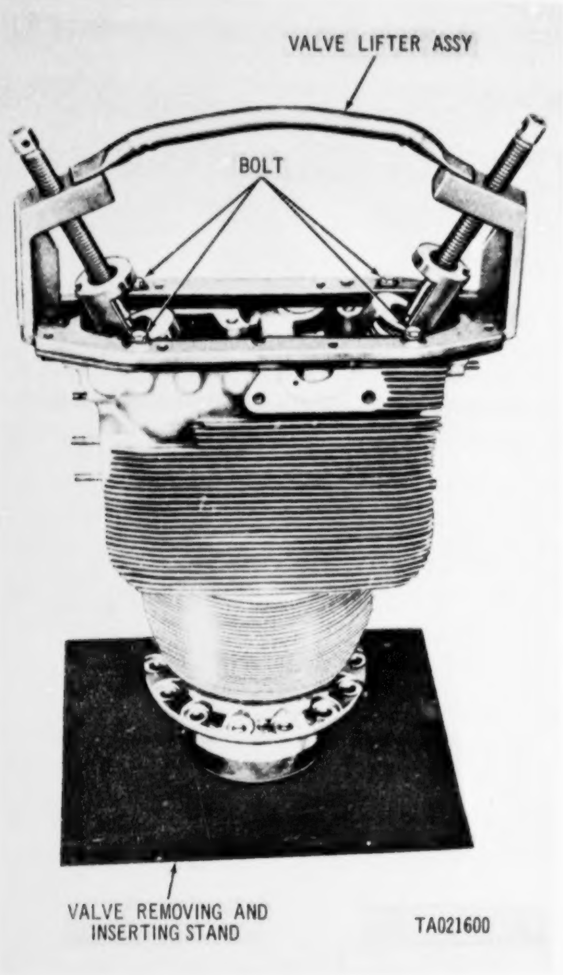

VALVE LIFTER ASSY
BOLT
VALVE REMOVING AND INSERTING STAND
TA021600

Figure 3-186. Cylinder showing position of valve lifter assembly and removing and inserting valve stand.

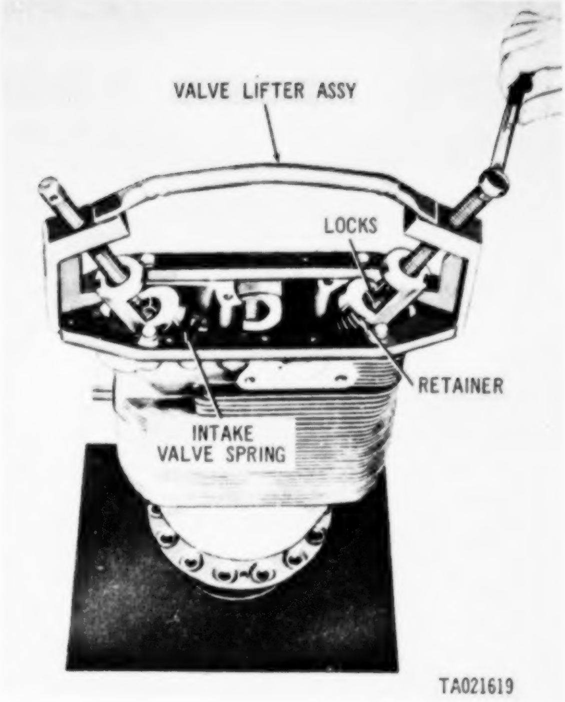

VALVE LIFTER ASSY
LOCKS
RETAINER
INTAKE VALVE SPRING
TA021619

Figure 3-187. Compressing exhaust valve springs to remove or install upper valve spring retainer locks.

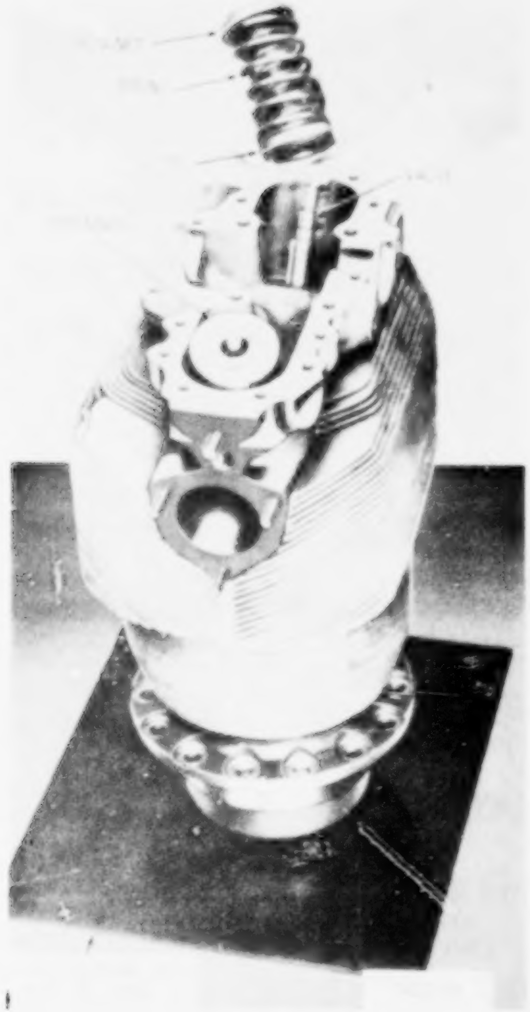


Figure 3-188. Removing or installing valve springs, upper retainers, and exhaust valve rotor.

b. Valve Rocker Arm Covers. Remove two plugs (13, fig. 3-190), and remove valve rocker shafts (14 and 31) from valve rocker cover (15). Shaft has a 1/4-28 UNC puller screw tapped opening. Remove exhaust valve rocker arm (29) and intake valve rocker arm (30). Remove valve rocker adjusting screw nuts (28) and remove valve rocker adjusting screws (34).

NOTE

Do not remove intake valve rocker arm bearing sleeves (32) and exhaust valve rocker arm bearing sleeves (33) unless inspection 3-71*d* indicates bearing sleeves must be replaced.

3-70. Cleaning

a. Clean cylinder and associated parts and remove heavy carbon deposits from combustion chamber with a scraper or blunt tool which will not nick or scratch the surface. Remove only the heavy carbon deposits. Surface need not be cleaned to a mirror finish.

b. Clean carbon from fuel injector nozzle seat using nozzle carbon cutter Part No. 10882949 as shown in figure 3-189.

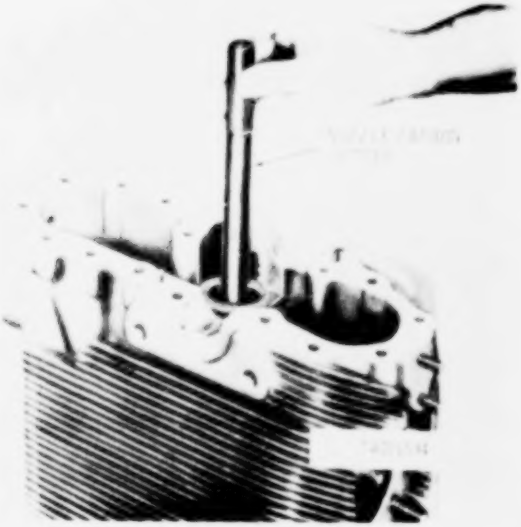
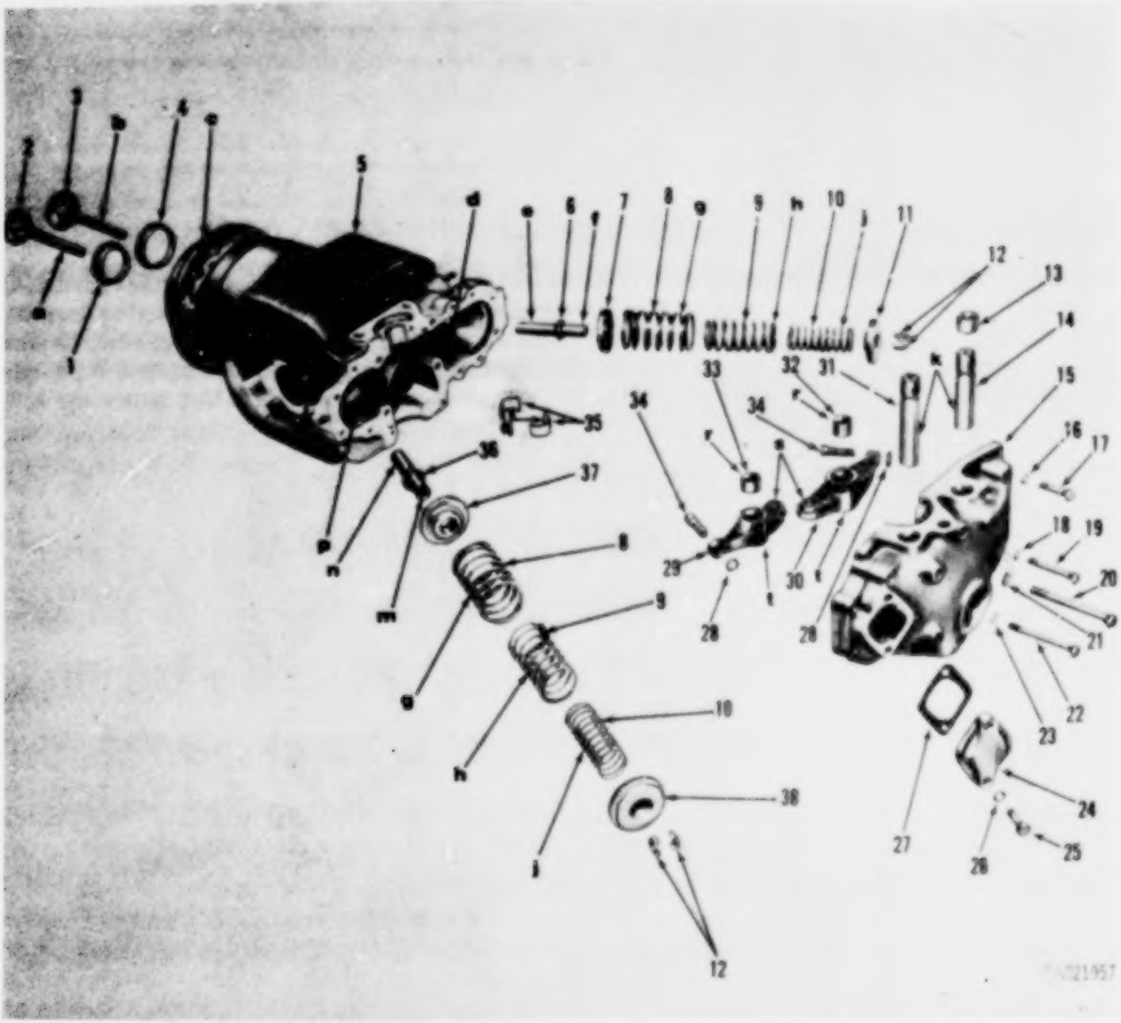


Figure 3-189. Cleaning carbon deposits from fuel injector nozzle seat using nozzle carbon cutter.

c. Soak cylinder in carbon removing compound to remove carbon and other foreign material from dome and valve ports.


2
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28
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17
18
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20
21
22
23
8
9
g
10
h
38
j
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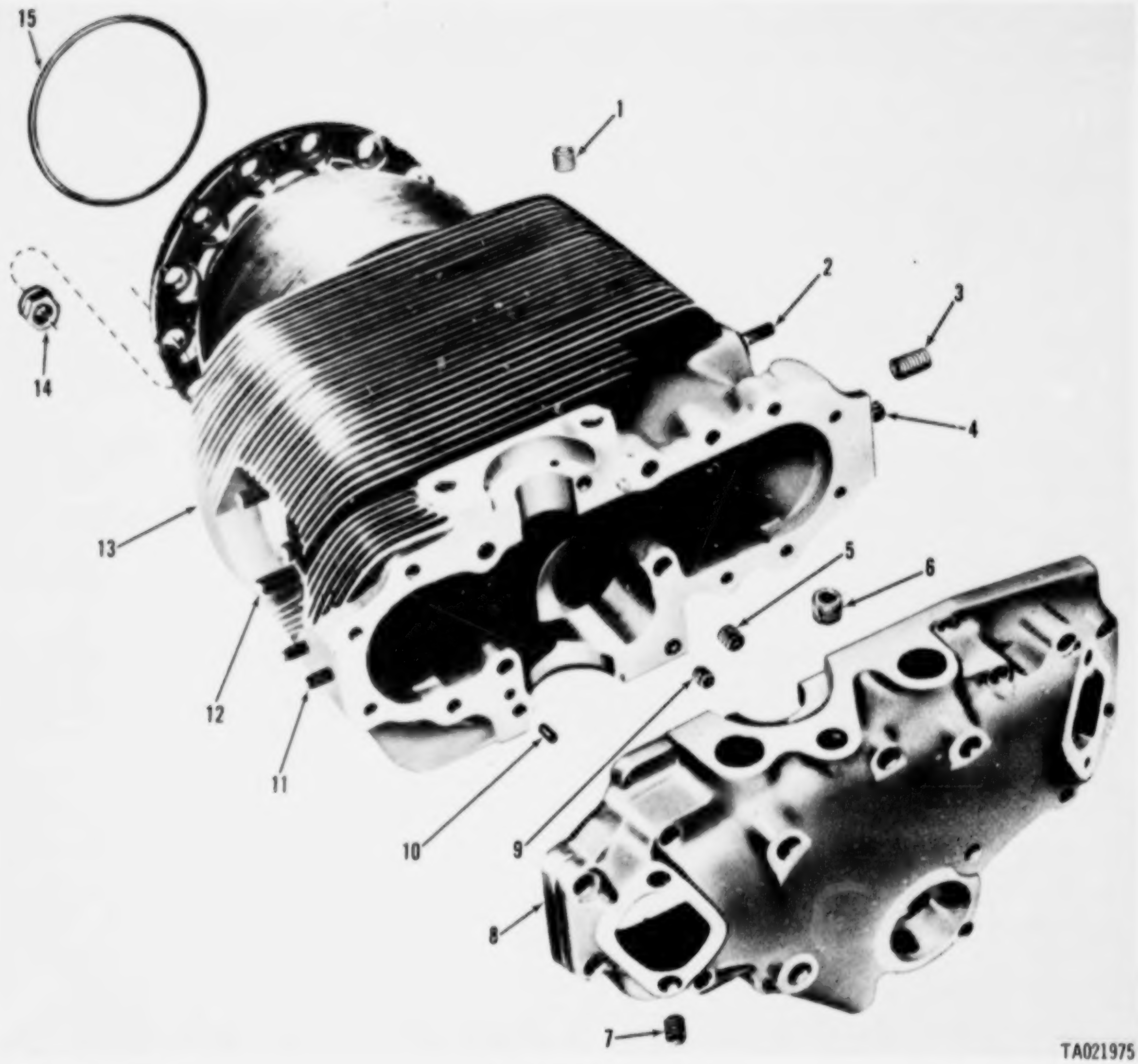
TA021957

1 Exhaust valve seat
2 Exhaust valve
3 Intake valve
4 Intake valve seat
5 Cylinder and head
6 Intake valve guide
7 Intake valve spring seat
8 Outer valve compression spring
9 Intermediate valve compression spring
10 Inner valve compression spring
11 Intake valve spring upper retainer
12 Intake and exhaust lock valve spring retainer
13 Valve rocker shaft hole plug
14 Intake valve rocker shaft
15 Valve rocker support cover
16 Flat washer
17 Machine bolt
18 Flat washer
19 Machine bolt
20 Machine bolt
21 Packing with retainer
22 Machine bolt
23 Flat washer
24 Valve adjusting access cover
25 Machine bolt
26 Flat washer
27 Valve adjusting cover gasket
28 Valve rocker adjusting screw nut
29 Exhaust valve rocker arm
30 Intake valve rocker arm
31 Exhaust valve rocker shaft
32 Intake valve rocker arm bearing sleeve
33 Exhaust valve rocker arm bearing sleeve
34 Valve rocker adjusting screw
35 Insert, cam bearing
36 Exhaust valve guide
37 Exhaust valve rotor
38 Exhaust valve spring upper retainer

Figure 3-190. Cylinder and head assembly and associated parts — exploded view.



1 Insert, screw thread
2 Intake manifold stud
3 Insert, screw thread
4 Stud, oil cooler support frame
5 Insert, screw thread
6 Insert, screw thread
7 Insert, screw thread
8 Cover
9 Insert, screw thread
10 Pin, straight, headless
11 Stud, plain
12 Stud, plain
13 Cylinder
14 Nut, extended washer
15 Preformed packing

Figure 3-191. Cylinder and head and associated parts – exploded view.

3-71. Inspection

a. Valve Guides. Inspect valve guides (6 and 36, fig. 3-190), for cracks, galling, erosion, or scuffing. Check guides against limits specified in the repair standards (table 3-13).

b. Valve Seat Inserts. Inspect inserts for pitted surfaces. If inserts are cracked, loose, or damaged beyond repair, the cylinder must be replaced. Check valve seat contact by lightly bluing face of insert with Prussian blue and placing a new valve into position on valve insert. Rotate valve one-half turn on insert and check valve seat for Prussian blue contact. Valve seat must show contact all around (360°), as indicated by Prussian blue transfer, to quality as a serviceable insert. Inserts that do not show 360° contact must be marked for repair. If valve seat inserts can be made serviceable by grinding; repair as outlined in paragraph 3-72.

c. Cylinder Bore Dimensions. Standard and oversize cylinder assemblies are identified by the steel stamped part number located on the cooling fan shroud bracket mounting flange on the exhaust port side of the cylinder assembly (fig. 3-192). See table 3-12 for oversize assembly identification number.

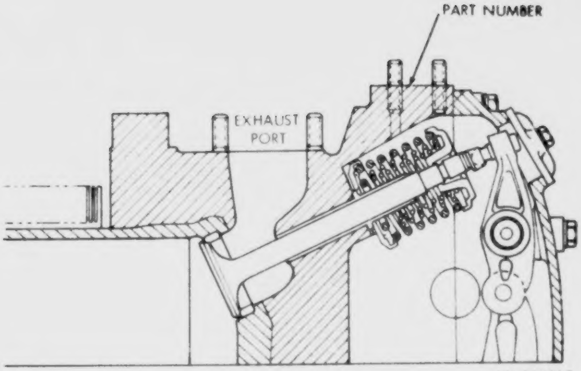


Figure 3-192. Location of standard and oversize cylinder assembly identification numbers.

Table 3-12. Tabulation of Standard and Oversize Cylinder Assembly Identification Numbers

Part number	Bore size	Bore diameter
10951304	STANDARD	5.751 - 5.753
10951304-1	0.010 OVERSIZE	5.761 - 5.763
10951304-2	0.020 OVERSIZE	5.771 - 5.773
10951304-3	0.030 OVERSIZE	5.781 - 5.783
10951304-4	0.040 OVERSIZE	5.791 - 5.793

(1) Cylinder bores may taper slightly at the head end (at room temperature). The tapered section expands and is essentially straight at operating temperature.

(2) With cylinder at room temperature, take two cylinder bore measurements at point A through E, repair standards (table 3-13) and fig. 3-193. Measure diameter approximately parallel to line of valves, and then take measurement 90 degrees to first measurement. Average the measurements.

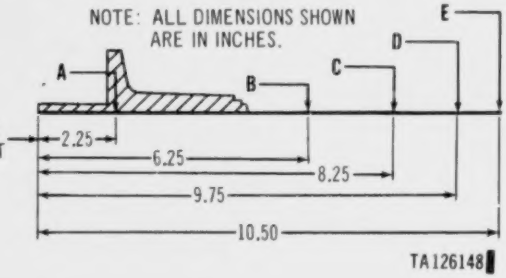


Figure 3-193. Cylinder bore dimensions.

(3) Head end average measurements must not exceed flange end average measurements.

(4) Compare the measurements taken 90 degrees apart. Each two measurements must be within 0.003 inches of each other. If the difference exceeds 0.003 inches, the cylinder is out-of-round and must be marked for repair.

(5) Inspect camshaft bearing inserts (35, fig. 3-190) for pitting, galling, burs, and nicks. Fine scratches on bearing inserts are not cause for rejection. Pitting or any other form of destruction to the bearing surface is cause for rejection. Spread a thin coat of Prussian blue over the backs of the bearing inserts and install in their original location on cylinder assembly and rocker box cover. Secure rocker box cover to cylinder assembly with four bolts (20) and washers (21). Torque tighten to 275-325 in. lbs. Check the insert diameter of bearing inserts (35) with a dial bore indicator against the limits specified in repair standards (table 3-13). Replace bearing inserts that do not meet these requirements.

(6) Inspect cylinder head and barrel cooling fins for possible repair (para 3-72*f*).

d. Valve Rocker Arm Covers and Associated Parts.

(1) *Valve rocker arm cover.* Inspect valve rocker support cover (15, fig. 3-190) for cracks. Inspect camshaft bearing insert surface for galling, pitting, burs, and nicks. Check cover against limits specified in repair standards (table 3-13). Check valve adjusting access cover (24, fig. 3-190) for cracks and for warpage. Replace cylinder assembly when cover is unserviceable.

(2) *Valve rocker arms.* Inspect valve rocker arms (29 and 30) for cracks, using a magnifying glass (five power magnification minimum) and a strong light. Inspect the bushing-type bearing

sleeves in the rocker arms for scoring and looseness. Check bearing sleeves against limits specified in repair standards (table 3-13). Replace bearing sleeve that do not meet these limits. Inspect valve rocker arm rollers for scuff or score marks and looseness on hub. Rotate roller and check clearance between roller and hub by mounting rocker arm securely in a soft-jawed vise. Set a dial indicator against contact surface of roller and move roller through extremes of its travel. Check reading on the dial indicator. Limits should be 0.0055 in. maximum. Replace rocker arms if rollers or hubs are damaged. Inspect adjusting screws (34) for stripped or damaged threads. Check screw by turning screw in and out of rocker arms. Screw must turn freely. Check swivel pad and adjusting screw for free rotation. Mark damaged parts for replacement.

(3) *Valve rocker arm shafts.* Check valve rocker arm shafts (14 and 31) for cracks, scuff, scores and metal pick up or plugged oil passages. Check shafts against limits specified in repair standards (table 3-13). Repair or replace unserviceable shafts (para 3-72*g*).

(4) *Valves.*

(a) Valve head. Check intake and exhaust valves (2 and 3, fig. 3-190) for evidence of pitting, imperfect seating, cracks or warpage on valve head. Heavy discoloration, burning, erosion, or a heavy carbon deposit on valve face indicates a warped valve. A light frosted appearance or minor discoloration on valve face does not indicate a warped or unserviceable valve.

(b) Valve stem. Inspect the valve stems and the locking groove in the stems for pitting, scoring, cracks, or damaged tips. Check valves against limits specified in repair standards (table 3-13). Replace valves that are warped, cracked, or unserviceable.

NOTE

Do not interpret termination of chrome plating on stem as a crack.

(5) *Valve springs.* Inspect inner spring (10, fig. 3-190), intermediate spring (9), and outer spring (8) for wear, cracks, set or other evidence of failure. Check all springs against limits specified in the repair standards (table 3-13).

(6) *Valve spring retainers, valve rotors, and locks.* Inspect valve spring retainers (11 and 38) and intake spring seat (7) for wear and cracks. Check exhaust valve rotor (37) by rotating inner section. Inner section must rotate freely. Inspect rotor for wear or cracks. Inspect spring retainer locks for wear or cracks. Worn locks will have ridges on top face. Replace any unserviceable parts.

NOTE

Three different models of exhaust valve rotors, all manufactured by one manufacturer, are optional in this cylinder assembly. Two of these optional rotors will rotate in either direction. The other optional rotor will rotate in one direction only.

Table 3-13. Cylinder Assembly Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Cylinder	3-193		Bore diameter A thru E	5.7510	5.7530	5.7580
Cylinder	3-193		0.0100 Oversize Bore diameter A thru E	5.7610	5.7630	5.7680
Cylinder	3-193		0.0200 Oversize Bore diameter A thru E	5.7710	5.7730	5.7780
Cylinder	3-193		0.0300 Oversize Bore diameter A thru E	5.7810	5.7830	5.7880
Cylinder	3-193		0.0400 Oversize Bore diameter A thru E	5.7910	5.7930	5.7990
	3-183		Maximum out-of-round of cylinder bore	0.0020		0.0040
	3-183	v	Piston diameter at bottom of skirt, 90 degrees to piston pin			
			Standard	5.7410	5.7420	5.7380
			0.0100 oversize	5.7510	5.7520	5.7480
			0.0200 oversize	5.7610	5.7620	5.7580
			0.0300 oversize	5.7710	5.7720	5.7680
			0.0400 oversize	5.7810	5.7820	5.7780
	3-183 3-190	v c	Fit of piston in cylinder bore measured up 2.250 inches from bottom of cylinder skirt, 90 degrees to piston pin	0.0075L	0.0115L	0.0215L
	3-190	p	Inside diameter of exhaust valve guide bore in cylinder head	0.7495	0.7505	*
	3-190	n	Outside diameter of exhaust valve guide			
			Standard	0.7525	0.7530	*
			0.0100 oversize	0.7625	0.7630	*
			0.0200 oversize	0.7725	0.7730	*
	3-190	n-p	Fit of exhaust valve guide in cylinder head bore	0.0020T	0.0035T	*
	3-190	q	Inside diameter of camshaft bearing in cylinder at proper torque tightness	1.3115	1.3135	1.3140
	3-257 3-258	g	Outside diameter of journals on camshafts	1.3090	1.3100	1.3085
	3-190 3-257 3-258	q-g	Fit of journal in bearing	0.0015L	0.0045L	0.0055L
Valve Guides and Valves	3-190	e	Outside diameter of intake valve guide			
			Standard	0.6890	0.6895	*
			0.0100 oversize	0.6990	0.6995	*
			0.0200 oversize	0.7090	0.7095	*
	3-190	d	Inside diameter of intake valve guide bore in cylinder head	0.6870	0.6880	*
	3-190	e-d	Fit of intake valve guide in bore	0.0010T	0.0025T	*

See foot note at end of table

Table 3-13. Cylinder Assembly Repair Standards — Continued

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts		Wear limits
Valve Guides and Valves	3-190	f	Inside diameter of intake valve guide	0.4995	0.5005	0.5035
	3-190	b	Outside diameter of intake valve stem	0.4975	0.4980	0.4970
	3-190	b-f	Fit of intake valve stem in guide	0.0015L	0.0030L	0.0065L
			Angle of intake valve seat with valve stem	74 degrees, 75 degrees,	45 minutes to 15 minutes	
	3-190	n	Outside diameter of exhaust valve guide			
			STD	0.7525	0.7530	•
			0.0100 oversize	0.7625	0.7630	•
			0.0200 oversize	0.7725	0.7730	•
	3-190	p	Inside diameter of exhaust valve guide bore in cylinder head	0.7495	0.7505	•
	3-190	n-p	Fit of exhaust valve guide in bore	0.0020T	0.0035T	•
	3-190	m	Inside diameter of exhaust valve guide	0.5615	0.5625	0.5655
	3-190	a	Outside diameter of exhaust valve stem in guide	0.5570	0.5580	0.5565
	3-190	a-m	Fit of exhaust valve stem in guide	0.0035L	0.0055L	0.0090L
			Angle of exhaust valve seat with valve stem	45 degrees, 45 degrees,	00 minutes to 15 minutes	
Valve springs	3-190	g	Outer valve compression spring (large)			
			Scale reading at 1.56 inch length	134.2 lbs ± 13.42 lbs		•
			Scale reading at 2.26 inch length	85.4 lbs ± 4.27 lbs		•
			Maximum solid height	1.47 inch		•
	3-190	h	Intermediate valve compression spring (medium)			
			Scale reading at 1.56 inch length	81.4 lbs ± 8.14 lbs		•
	3-190	h	Scale reading at 2.26 inch length	51.7 lbs ± 2.60 lbs.		•
			Maximum solid height	1.34 inch		•
	3-190	j	Inner valve compression spring (small)			
			Scale reading at 1.37 inch length	43.9 lbs ± 4.39 lbs		•
			Scale reading at 2.07 inch length	26.2 lbs ± 1.31 lbs		•
			Maximum solid height	1.28 inch		•
Rocker arms and rocker arm shafts	3-190	k	Outside diameter of valve rocker arm shafts	0.7480	0.7485	0.7470
	3-190	r	Inside diameter of sleeve in rocker arm	0.7495	0.7505	0.7520
	3-190	k-r	Fit of shaft in sleeve bearing	0.0010L	0.0025L	0.0050L
	3-190	t	Side clearance between rocker covers and rocker arms	0.0060	0.0140	0.0200
	3-190	s	Rocker roller radial clearance	0.0020L	0.0030L	0.0055L

Refer to paragraph 3-87c for explanation of symbols.

Table 3-14. Cylinder Standard Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd.	Stud size and length
3-191	2	31/32	36	5/16-18 (13/16) x 5/16-24 (19/32) x 1-11/16
3-192	4	1-3/32	12	7/16-14 (25/32) x 7/16-20 (1-1/64) x 1-27/32
3-191	11	21/32	24	5/16-18 (11/16) x 5/16-24 (9/16) x 1-5/16
3-191	12	31/32	48	3/8-16 (53/64) x 3/8-24 (7/8) x 1-3/4

3-72. Repair

a. Cylinder Interior.

(1) ***Valve guide replacement.***

(*a*) Replace any cracked, galled, eroded, or scuffed intake and exhaust valve guides (6 and 36, fig. 3-190) or guides which do not conform to limits specified in repair standards (table 3-13).

NOTE

The intake and exhaust valve guides are removed from the cylinder in the same manner. Mechanical puller Part No. 10882953 is used for intake valve guide removal and mechanical puller Part No. 10882954 is used for exhaust valve guide removal.

(*b*) Insert screw of mechanical puller Part No. 10882953 through the valve guide and puller (fig. 3-186). Install nut on end of puller screw and tighten to remove valve guide from cylinder.

WARNING

Wear gloves when handling heated parts.

NOTE

Preheat entire assembly in oven to 350°F. maximum before removing valve guide.

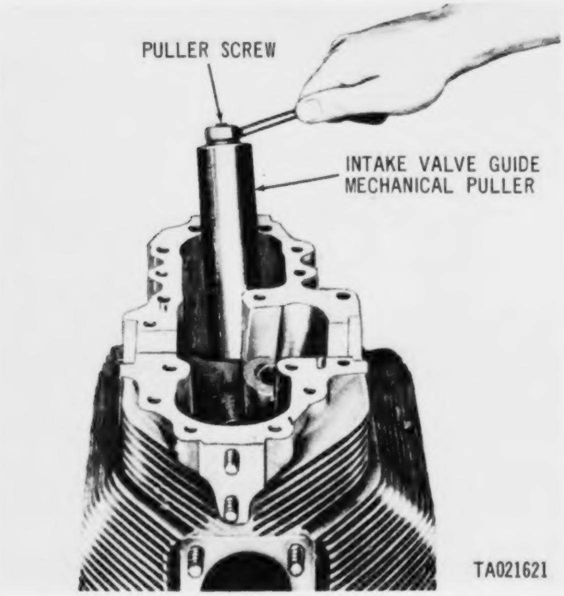


Figure 3-194. Removing intake valve guide using mechanical puller.

NOTE

The intake and exhaust valve guides are installed in the same manner. Valve guide replacer Part No. 10883052 is used for replacing intake valve guide, and valve guide replacer Part No. 10883053 is used for replacing exhaust valve guide.
Heat cylinder assembly to 350°F. max. and chill guides before installing.

(*c*) Remove ferrule (fig. 3-195) from end of valve guide replacer.

(*d*) Place new valve guide over replacer with short end of guide entering hollow replacer handle. Replace ferrule to retain guide or replacer.

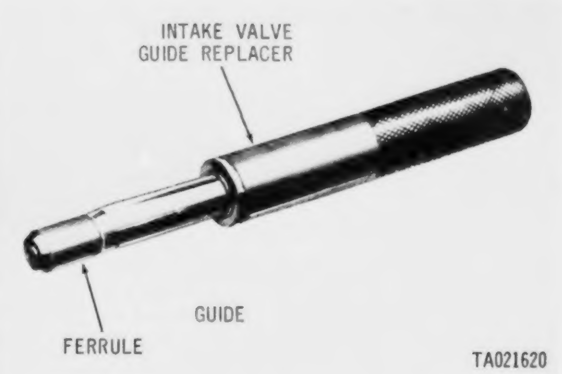


Figure 3-195. Positioning intake valve guide on valve guide replacer.

(*e*) Place assembled intake valve guide (fig. 3-196) and valve guide replacer Part No. 10883052 into valve guide bore in cylinder. Carefully drive guide into cylinder until flange on guide is positioned against top face of guide bore.

(*f*) Remove ferrule from replacer and withdraw replacer from valve guide. Install exhaust valve guide in the same manner using valve guide replacer Part No. 10883053.

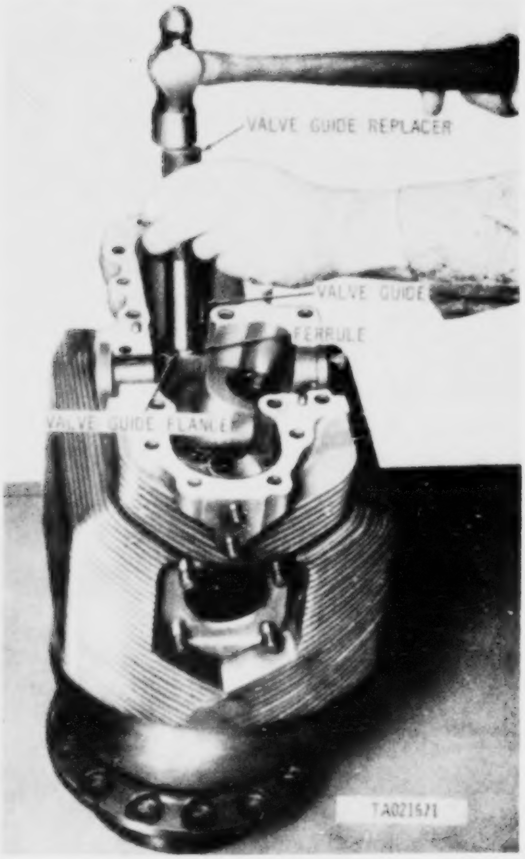

VALVE GUIDE REPLACER
VALVE GUIDE
FERRULE
VALVE GUIDE FLANGE
TA021571

Figure 3-196. Installing intake valve guide using valve guide replacer.

NOTE

After new valve guides are installed, they must be reamed to specified size to assure proper clearance between valve guide and valve stem.

(g) Install the reamer bushing Part No. 11642088 into intake valve seat as shown in figure 3-197. Use hand reamer Part No. 708398 to rough ream and hand reamer Part No. 7083699 to finish ream intake valve guides as shown in figures 3-197 and 3-198. The exhaust valve guides may be reamed in a similar manner using reamer bushing Part No. 11642089, rough hand reamer Part No. 7083696, and finish hand reamer Part No. 7083697.

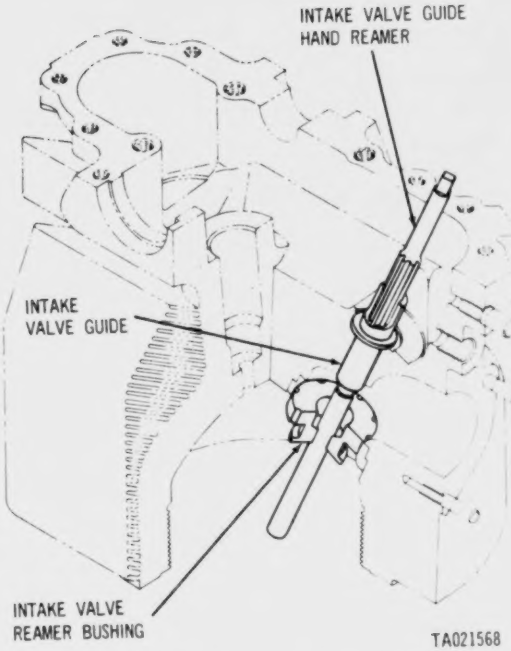

INTAKE VALVE GUIDE HAND REAMER
INTAKE VALVE GUIDE
INTAKE VALVE REAMER BUSHING
TA021568

Figure 3-197. Intake valve guided hand reamer and reamer bushing positioned in cylinder head — sectional view.

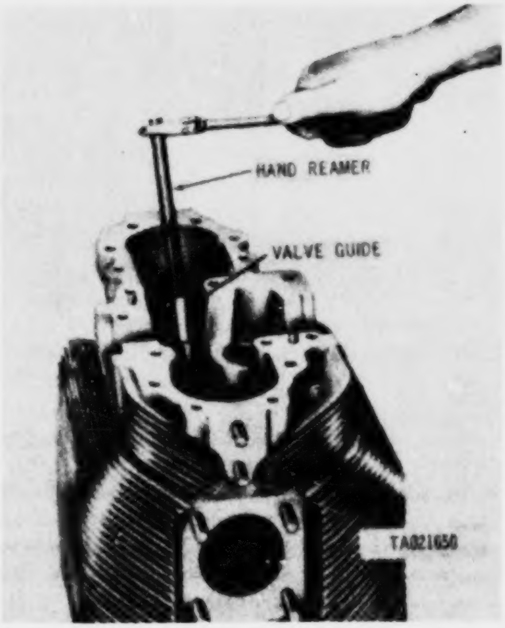

HAND REAMER
VALVE GUIDE
TA021650

Figure 3-198. Reaming intake valve guide, using hand reamer and reamer bushing.

(2) *Valve seats.* Replace cylinder assembly (5, fig. 3-190) when inserts are cracked, loose or excessively worn in the cylinder. Grind seats which do not show 360° contact with valve face. Grind inserts (fig. 3-199) as described in (*a*) and (*b*) below.

(*a*) A 45 degree angle grinding stone must be used to grind exhaust valve seat and a 15 degree angle grinding stone must be used for intake valve seats. Dress seat on the insert with stone, using valve seat grinding machine. After dressing seat of insert, check valve contact as described in paragraph 3-71*b*.

(*b*) When 360° contact is obtained, narrow seat on insert to width specified in figure (3-199) by grinding inner wall and exposed face of insert to the angles specified. Keep valve seat area as near as possible to center of valve face. Valves should never seat at the top or bottom of the valve face area.

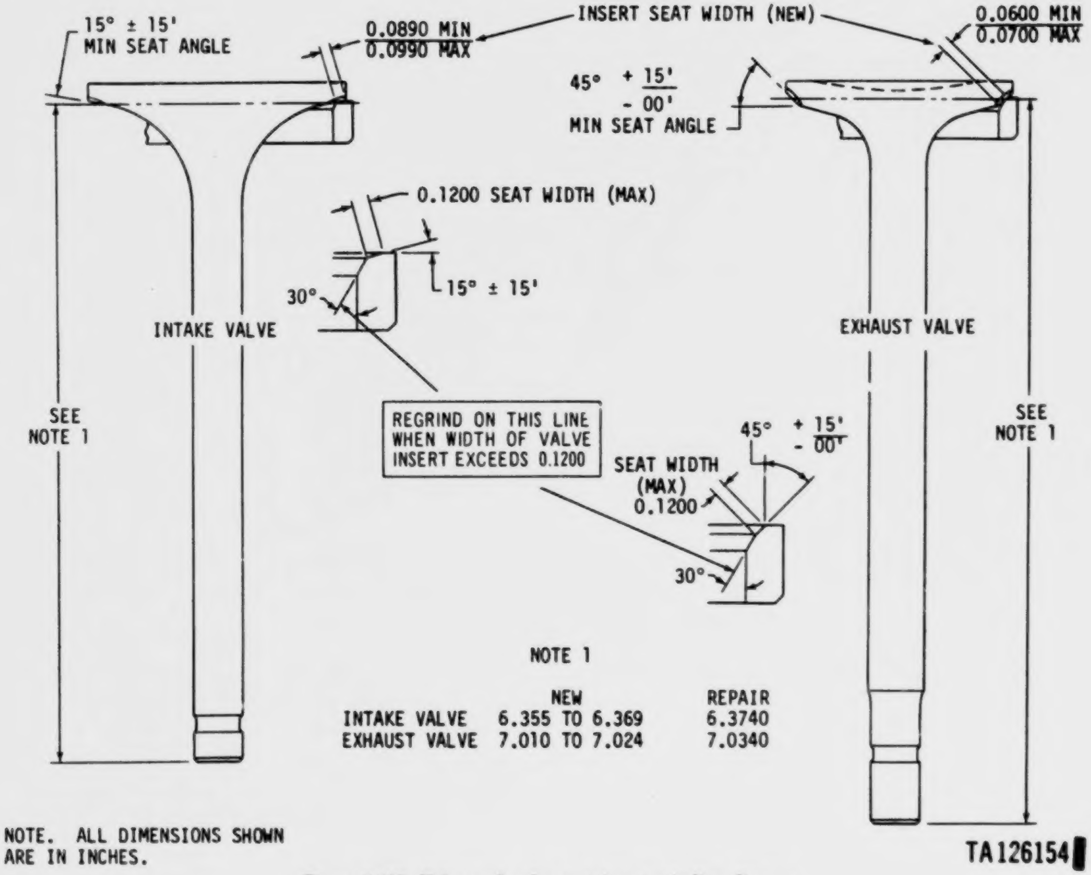

15° ± 15'
MIN SEAT ANGLE
0.0890 MIN
0.0990 MAX
INSERT SEAT WIDTH (NEW)
0.0600 MIN
0.0700 MAX
45° + 15' - 00'
MIN SEAT ANGLE
0.1200 SEAT WIDTH (MAX)
15° ± 15'
30°
INTAKE VALVE
EXHAUST VALVE
SEE NOTE 1
REGRIND ON THIS LINE WHEN WIDTH OF VALVE INSERT EXCEEDS 0.1200
45° + 15' - 00'
SEAT WIDTH (MAX) 0.1200
30°
SEE NOTE 1
NOTE 1
NEW
REPAIR
INTAKE VALVE 6.355 TO 6.369 6.3740
EXHAUST VALVE 7.010 TO 7.024 7.0340
NOTE. ALL DIMENSIONS SHOWN ARE IN INCHES.
TA126154

Figure 3-199. Valve and valve seat insert grinding diagram.

b. Cylinder Bore. Replace cylinder assembly when cylinder bore dimensions are not within limits specified in the repair standards (table 3-13), or when average dome end measurement is larger than average flange end measurement. The cylinder assembly should also be replaced when the cylinder bore has excessive scratches, scoring or ring ridge or when the bore is glazed or smooth.

c. Camshaft Bearing Sleeves. Fine scratches on the bearing surface are not cause for rejection. Replace camshaft bearings when the bearing surfaces are scored, galled, or deeply pitted, or when bearings do not conform to the limits specified in the repair standards (table 3-13).

d. Cylinder Exterior.

(1) *Cooling fins.* Straighten bent fins as near as possible to their original spacing. Replace cylinder assembly when more than one percent of barrel cooling fin area is broken. Replace cylinder assembly if head fin is broken more than half the depth of the fin or more than two inches long. A cylinder assembly can be used if it has not more than three acceptable defects, or if no two of the defects are on adjacent fins. Repair damaged cylinder head fins as

described in (*a*) and (*b*) below.

(*a*) Use a fine mill file to remove sharp corners of broken head fins. Do not remove more metal than necessary to produce a smoothly blended edge on the damaged fin.

(*b*) Depth of any blended fin must not be less than 50 percent of its original depth. When blended fin is less than 50 percent of original depth, replace cylinder assembly.

(2) *Studs and inserts.* Replace damaged, bent or stripped studs as described in paragraph 3-38 and Cylinder Standard Stud Identification (table 3-14). Replace defective helical-coil inserts as described in paragraph 3-39.

e. Valve Rocker Arm Covers.

(1) Repair or replace damaged parts. Replace cylinder assembly when valve rocker arm cover is cracked or has deep scratches or nicks on the mating surface. Replace cylinder when cover damaged cannot be removed by polishing with crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II).

(2) Replace cylinder assembly when valve rocker cover does not conform to limits specified in the repair standards (table 3-13). Replace damaged screw thread inserts as instructed in paragraph 3-39. Replace cracked adjusting covers. Remove minor nicks, burs, or scratches from mating surface with crocus cloth dipped in dry-cleaning solvent (P-D-680, Type II).

f. Valve Rocker Arm.

(1) Replace valve rocker arms (29 and 30, fig. 3-190) when cracked or worn or if the valve rocker arm roller and bushing are worn or damaged.

(2) Replace adjusting screw (34) when threads are stripped or damaged or when screw binds in rocker arm. Replace adjusting screw when swivel pad does not rotate freely on screw.

g. Valve Rocker Arm Shaft Assemblies.

(1) Replace cracked or deeply scored rocker arm shaft assemblies (14 and 31, fig. 3-190).

(2) Replace rocker arm shafts that do not conform to limits specified in the repair standards (table 3-13).

h. Valve, Springs, Spring Retainers and Rotors.

(1) *Valves.*

(*a*) Discard valves (2 and 3, fig. 3-190) which do not conform to limits specified in repair standards (table 3-13). Discard valves having warped, cracked, pitted or burned faces. Discard valves having badly pitted, scored, scratched stems or locking grooves.

(*b*) Reface slightly pitted or burned valves that do not have 360° of contact to limits specified in figure 3-199. Discard valves that cannot be refaced to these limits. Check valve length from seat contact to tip of stem after grinding, as shown in figure 3-199. Discard valve if length is not within limits specified.

(2) *Valve springs.* Replace springs (8, 9, and 10, fig. 3-190) when worn, cracked or otherwise damaged. Replace springs that do not conform to limits specified in repair standards (table 3-13).

(3) *Valve spring retainers, valve rotors, and valve locks.*

(*a*) Replace upper intake and exhaust valve spring retainers (11 and 38, fig. 3-190) and valve spring seat (7) when cracked or worn.

(*b*) Replace valve rotors (37) when inner section does not rotate freely or when assembly is worn or cracked. Replace valve lock spring retainers (12) when worn or cracked.

3-73. Assembly

a. Cylinders.

(1) Install intake valve (3, fig. 3-190) and exhaust valve (2) in their respective guides in cylinder (5). Hold valves in position and place the cylinder on valve removing and inserting stand (fig. 3-186).

(2) Install the exhaust valve rotor (37, fig. 3-186) outer, intermediate and inner springs (8, 9, and 10), and exhaust valve spring upper retainer (38) over the exhaust valve stem as shown in figure 3-188. Install the lower intake valve spring seat (7) outer, intermediate and inner springs (8, 9, and 10), and upper intake valve spring retainer (11) over the intake stem in the same manner. Compress valve springs and install valve locks following instructions which accompany figure 3-200.

(*a*) Position the valve lifter assembly Part No. 8761535 over the valve springs and retainers and secure in position with four 5/16 x 1-3/8 bolts and 5/16 in. flat washers.

(*b*) Compress valve springs and retainers with screws and install two valve lock spring retainers (12) in the groove of each valve stem. Release valve spring compression. Remove valve lifter assembly Part No. 8761535 from cylinder and remove cylinder from stand.

(c) Check valves for leakage by placing cylinder on its side with intake or exhaust port up and filling valve port with dry-cleaning solvent (P-D-680, Type II) and observing valve seat area for fluid leakage.

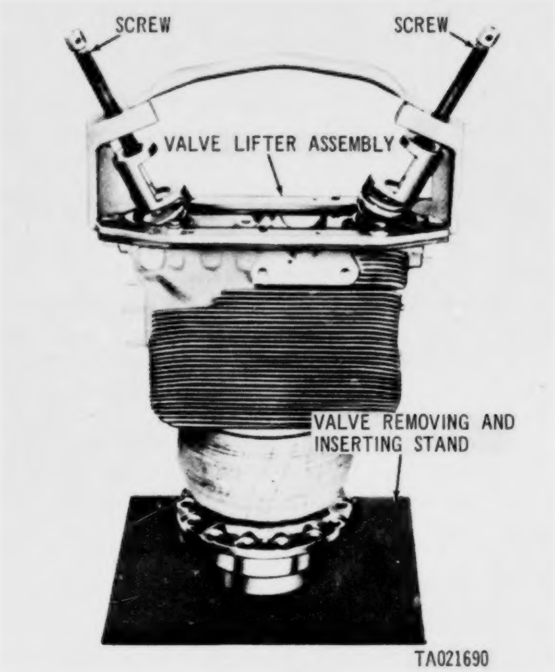

SCREW
SCREW
VALVE LIFTER ASSEMBLY
VALVE REMOVING AND INSERTING STAND
TA021690

Figure 3-200. Compressing valve springs using valve lifter assembly.

b. Valve Rocker Arm Covers. Install valve rocker adjusting screws (34) and nuts (28, fig. 3-190). Position intake valve rocker arm (30) in valve rocker cover (15) and install valve rocker shaft (14). Install plug (13). Position exhaust valve rocker arm (29) in valve cover (15) and install valve rocker shaft (31). Install plug (13).

NOTE Deleted.

Section X. REPAIR OF OIL PUMP ASSEMBLY AND ASSOCIATED PARTS

3-74. General

This section covers the repair of the oil pump assembly (fig. 3-201) and associated parts. Specific instruction on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Stud identification information is included in the repair procedures.

3-75. Disassembly

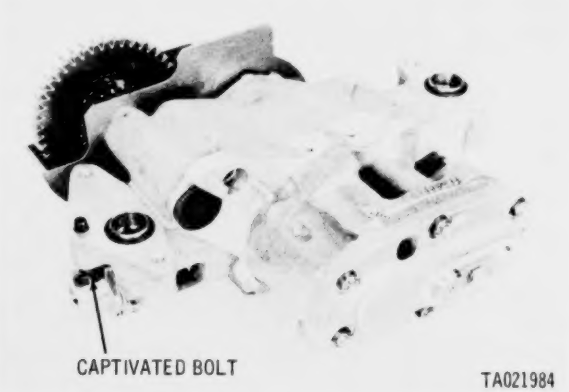
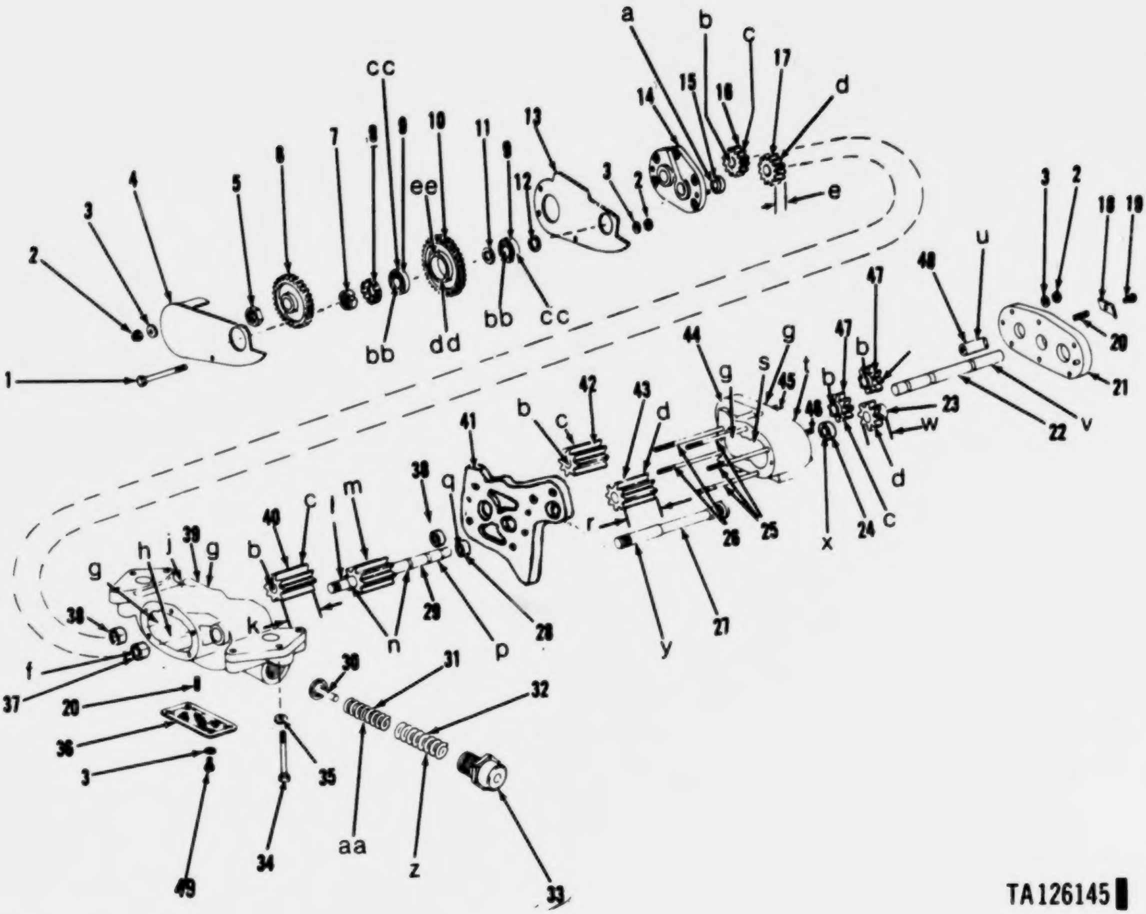
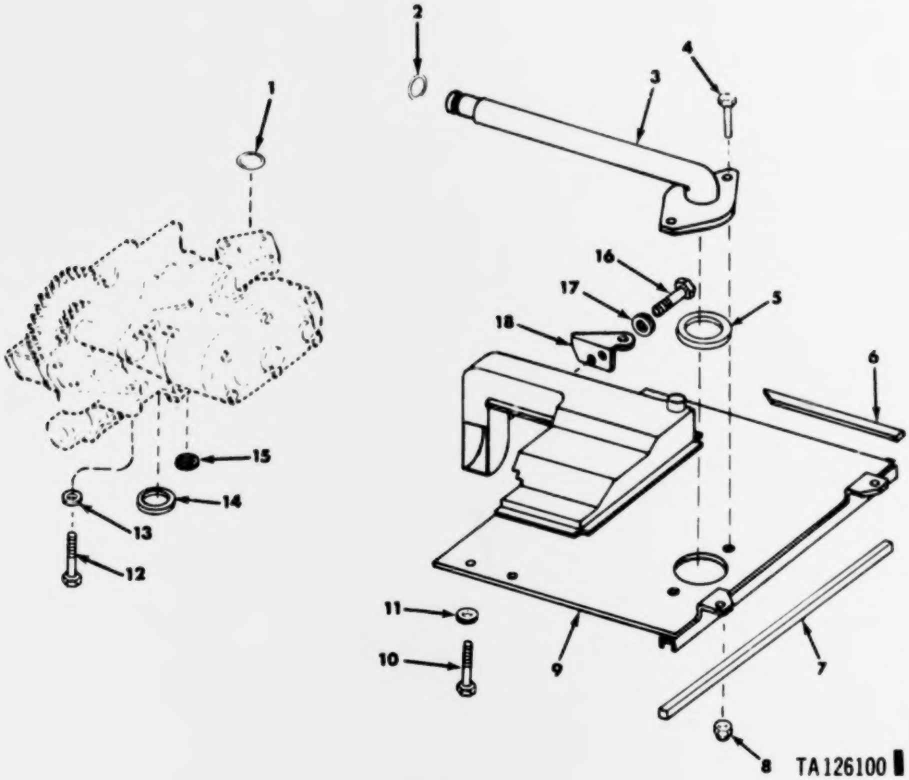

CAPTIVATED BOLT
TA021984

Figure 3-201. Oil pump assembly.


a
b
c
17
d
cc
15
16
14
13
12
11
10
9
8
7
6
5
4
3
2
1
ee
e
bb
dd
bb
cc
3
2
18
19
20
21
u
48
47
b
v
22
23
w
d
c
24
x
46
b
47
45
t
s
g
44
42
43
c
b
d
41
r
26
25
27
y
38
q
m
l
c
40
b
h
j
39
g
g
38
f
37
20
36
3
49
k
n
29
p
28
30
31
32
33
35
34
aa
z
TA126145

1 Machine bolt
2 Self-locking nut
3 Flat washer
4 Oil pump gear cover
5 Self-locking nut
6 Oil pump impeller drive spur gear
7 Plain nut
8 Washer key
9 Annular ball bearing
10 Oil pump drive cluster spur gear
11 Thrust washer
12 Thrust washer bearing
13 Oil pump gear plate
14 Pressure oil pump housing cover
15 Bearing, sleeve
16 Level oil pump driven impeller
17 Level oil pump drive impeller
18 Lock plate
19 Machine bolt
20 Screw thread insert
21 Scavenge oil pump housing cover
22 Oil pump driven impeller shaft
23 Make-up oil pump drive impeller
24 Scavenge oil pump bearing
25 Stud
26 Stud
27 Oil pump drive gear shaft
28 Bearing sleeve spacer
29 Oil pump impeller drive shaft
30 Oil pump pressure relief valve
31 Oil pump pressure relief valve inner compression spring
32 Oil pump pressure relief valve outer compression spring
33 Oil pump pressure relief valve cap
34 Capscrew
35 Flat washer
36 Pressure oil pump intake screen
37 Pressure oil pump bearing sleeve
38 Bearing sleeve
39 Pressure oil pump housing
40 Pressure oil pump driven impeller
41 Pressure and scavenge oil pump housing spacer
42 Scavenge oil pump driven impeller
43 Scavenge oil pump drive impeller
44 Scavenge oil pump housing
45 Stud
46 Stud
47 Driven oil pump oil make-up impeller
48 Make-up oil pump drive shaft
49 Machine bolt

Figure 3-202. Oil pump assembly — exploded view.



1. Preformed packing
2. Preformed packing
3. Oil pump transfer leveling tube assembly
4. Capscrew
5. Seal
6. Rubber strip
7. Rubber strip
8. Self-locking nut
9. Oil pan pressure compartment baffle
10. Machine bolt
11. Lockwasher
12. Hexagon capscrew
13. Flat washer
14. Seal
15. Seal
16. Machine bolt
17. Lockwasher
18. Pressure compartment bracket

Figure 3-203. Oil pump assembly and associated parts.

a. Cut locking wire and remove oil pump pressure relief valve cap (33, fig. 3-202). Separate pressure relief valve (30), outer compression spring (32), and inner compression spring (31) from valve cap. Remove capscrew (34) and flat washer (35) from pump mounting flange. Remove and discard two preformed packings (1, fig. 3-203), seal (14) and two seals (15). Remove two self-locking nuts (2, fig. 3-202), two flat washers (3) attaching oil pump gear cover (4) to oil pump. Remove three self-locking nuts (2) and flat washers (3). Remove three bolts (1), and remove gear cover (4). Straighten tabs on washer key (8) and remove plain nut (7) and washer key (8) from oil pump drive gear shaft (27). Remove oil pump drive cluster gear (10) and thrust washer bearing (12) from oil pump drive gear shaft (27). Position a brass rod or drift between scavenge oil pump driven and drive impellers (42 and 43) through opening in scavenge oil pump housing to hold impellers stationary. Remove self-locking nut (5) and remove oil pump impeller drive spur gear (6). Remove oil pump gear plate (13). Remove remaining three self-locking nuts (2) and flat washers (3) securing pressure oil pump housing cover (14) to pressure oil pump housing (39). Remove housing cover (14). Remove level oil pump driven impeller (16) from oil pump driven impeller shaft. Remove level oil pump drive impeller (17) from oil pump impeller drive shaft.

b. Remove lock plate bolt (19) securing lock plate (18) to scavenge oil pump housing cover assembly. Remove lock plate. Remove six self-locking nuts (2) and flat washers (3) securing cover assembly (21) to scavenge oil pump housing (44). Remove cover assembly. Remove two driven make-up oil pump impellers (47) and one make-up oil pump drive impeller (23) from scavenge oil pump housing (44). Remove make-up oil pump drive shaft (48) and oil pump driven impeller shaft (22). Remove scavenge oil pump housing (44) from pressure oil pump housing (39). Remove scavenge oil pump driven impeller (42) and scavenge oil pump drive impeller (43) from scavenge oil pump housing. Remove pressure and scavenge oil pump housing spacer (41) from pressure oil pump housing (39) and remove oil pump drive gear shaft (27) from spacer. Remove oil pump impeller drive shaft (29) and pressure oil pump driven impeller (40) from pressure oil pump housing (39). Remove four oil pump intake screen machine bolts (49) and flat washers (3) and remove pressure oil pump intake screen (36) from pressure oil pump housing (39).

3-76. Cleaning

Refer to paragraph 3-36.

3-77. Inspection

Refer to paragraph 3-37. Inspect parts against limits specified in the repair standards (table 3-15).

3-78. Repair

Refer to paragraph 3-38d and oil pump stud identification (table 3-12). Refer to paragraph 3-39 when replacing helical-coil and screw thread inserts. Replace damaged studs and parts that do not conform to limits specified in repair standards (table 3-15).

Table 3-15. Oil Pump Repair Standards

Component	Fig. No.	Ref. Letter	Point of measurement	Sizes and fits of new parts		Wear limits
Depth of impeller bores	3-202	h	Level pump	0.8030	0.8050	0.8055
		j	Pressure pump	2.4320	2.4340	2.4345
		s	Scavenge pump	3.0480	3.0500	3.0505
		t	Make-up pump	0.2130	0.2150	0.2155
Length of impellers		e	Drive and driven level pump	0.8000	0.8010	0.7990
	3-202	e-h	End play between impellers and impeller housings with housings correctly installed	0.0020L	0.0050L	0.0065L
		k	Drive and driven pressure pump	2.4280	2.4290	2.4275
		k-j	End play between impellers and impeller housings with housings correctly installed	0.0030L	0.0060L	0.0070L
		r	Drive and driven scavenge pump	3.0410	3.0420	3.0405
	3-202	r-s	End play between impellers and impeller housings with housings correctly assembled.	0.0060L	0.0090L	0.0100L
		w	Drive and driven make-up pump.	0.2100	0.2110	0.2095
		w-t	End play between impellers and impeller housings with housings correctly assembled.	0.0020L	0.0050L	0.0060L
Impellers and shafts	3-202	l	Outside diameter of level pump end of pressure oil pump impeller drive shaft.	0.9835	0.9840	0.9832
	3-202	a	Inside diameter of bearing installed in pressure pump end cover.	0.9850	0.9860	0.9870
		l-a	Fit of shaft in bearing.	0.0010L	0.0025L	0.0038L
		n	Outside diameter of pressure pump and scavenge pump housing spacer bearing surfaces on oil pump impeller drive shaft.	1.1315	1.1320	1.1312
		f	Inside diameter of bearing installed in oil pressure pump housing.	1.1330	1.1340	1.1350
	3-202	n-f	Fit of impeller drive shaft in pressure housing bearing.	0.0010L	0.0025L	0.0038L
		q	Inside diameter of bearing installed in pressure and scavenge pump housing spacer.	1.1330	1.1340	1.1850
		n-q	Fit of impeller drive shaft in spacer bearing.	0.0010L	0.0025L	0.0038L

See foot note at end of table.

Table 3-15. Oil Pump Repair Standards — Continued

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts		Wear limits
Impellers and shafts		p	Outside diameter of scavenge pump housing bearing surface end of impeller drive shaft.	0.9835	0.9840	0.9832
	3-202	x	Inside diameter of bearing installed in scavenge pump housing	0.9850	0.9860	0.9870
		p-x	Fit of impeller drive shaft in scavenge pump housing bearing	0.0010L	0.0025L	0.0038L
		m	Outside diameter of impeller on oil pump impeller drive shaft	2.4814	2.4818	2.4810
		g	Inside diameter of level, pressure, scavenge and reserve pump impeller bores	2.4850	2.4862	2.4875
	3-202	m-g	Fit (radial clearance) of pressure pump drive impeller shaft in housing	0.0032L	0.0048L	0.0065L
		d	Outside diameter of level, scavenge and make-up pump drive impellers	2.4794	2.4798	2.4789
		d-g	Fit (radial clearance) of level scavenge and make-up drive impellers in housings	0.0052L	0.0068L	0.0086L
		c	Outside diameter of level, pressure, scavenge and make-up pump driven impellers	2.4774	2.4778	2.4769
	3-202	c-g	Fit (radial clearance) of driven impellers in housings.	0.0072L	0.0088L	0.0106L
		b	Inside diameter of level, pressure, scavenge and make-up pump driven impellers.	0.9860	0.9865	0.9870
		v	Outside diameter of oil pump driven impeller shaft.	0.9834	0.9839	0.9829
		b-v	Fit of driven impellers on shaft.	0.0021L	0.0031L	0.0041L
		u	Outside diameter of make-up oil pump driven impeller shaft.	0.9834	0.9839	0.9829
	3-202	b-v	Fit of impeller on shaft.	0.0021L	0.0031L	0.0041L
Oil pump drive gear and bearings.	3-202	cc	Outside diameter of drive spur gear bearings.	2.0467	2.0472	
		ee	Inside diameter of small gear end of drive gear.	2.0463	2.0470	2.0473
		cc-ee	Fit of bearing in drive spur gear.	0.0003L	0.0009T	0.0006L
		dd	Inside diameter of large gear end of drive gear.	2.0463	2.0470	2.0473
		cc-dd	Fit of bearing in drive spur gear.	0.0003L	0.0009T	0.0006L
	3-202	bb	Inside diameter of spur gear bearings	0.9839	0.9843	*
		y	Outside diameter of threaded end of oil pump drive shaft	0.9835	0.9840	0.9833
		bb-y	Fit of bearings on shaft	0.0008L	0.0001T	0.0010L
Oil pump pressure relief valve.	3-202	aa	Spring helical compression (small).			
			Approximate free length.	4.27 inch		*
			Load at 3.22 inch.	95 lb to 105 lb		*
			Maximum solid height.	2.94 inch		*

See foot note at end of table.

Table 3-15. Oil Pump Repair Standards – Continued

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts	Wear limits
Oil pump pressure relief valve	3-202	z	Spring helical compression (small).		
			Approximate free length.	4.96 inch	*
			Load at 3.22 inch.	141.5 lb to 156.5 lb	*
			Maximum solid height.	2.90 inch	

Refer to paragraph 3-37*c* for explanation of symbols.

Table 3-16. Oil Pump Standard Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-202	25	5-9/32	3	5/16-18 (3/4) x 5/16-24 (13/16) x 5-11/16
	26	5-11/16	2	5/16-18 (3/4) x 5/16-24 (13/16) x 6.00
	45	29/32	5	5/16-18 (3/4) x 5/16-24 (9/16) x 1-5/16
	46	2-1/64	1	5/16-18 (5/8) x 5/16-24 (13/16) x 2-9/16

Refer to figure 3-141 for oversize stud identification.

3-79. Assembly

a. Install pressure oil pump intake screen (36, fig. 3-202) on pressure oil pump housing (39) and secure with four flat washers (2) and oil pump screen bolts (2). Install pressure oil pump driven impeller (40) and oil pump impeller drive shaft (29) in pressure oil pump housing (39). Install oil pump drive gear shaft (27) in pressure and scavenge oil pump spacer (41) and install spacer on oil pump housing (39). Install scavenge oil pump drive impeller (43) and scavenge oil pump driven impeller (42) in scavenge oil pump housing (44). Install scavenge oil pump housing (44) on pressure oil pump housing (39). Install one make-up pump drive impeller (23) and two driven oil pump impellers (47) in scavenge oil pump housing (44). Install make-up oil pump drive shaft (48) and oil pump driven impeller shaft (22). Install cover assembly (21) to scavenge oil pump housing (44), and secure with six flat washers (3) and self-locking nuts (2).

b. Install lock plate (18) on scavenge oil pump housing cover assembly and secure with machine bolt (19). Install level oil pump drive impeller (17) on oil pump impeller drive shaft (29) and level oil pump driven impeller (16) on oil pump driven shaft (22). Install pressure oil pump housing cover (14) on oil pump housing (39) and secure with three flat washers (3) and self-locking nuts (2). Install oil pump gear plate (13). Install thrust washer bearing (12) and oil pump drive cluster gear (10) on oil pump drive gear shaft (27). Install new washer key (8) and plain nut (7). Position a brass rod or drift between scavenge oil pump driven and drive impellers through opening in scavenge oil pump housing to hold impellers stationary. Tighten plain nut (7). Torque tighten nut to 575-625 lb. in. Bend tabs on washer key (8) securing plain nut (7). Install oil pump impeller drive gear (6) and secure with self-locking nut (5). Torque tighten self-locking nut to 700-780 lb. in. Install spacer and oil pump gear cover (4). Secure cover (4) with bolt (1) and self-locking nut (2) and flat washer (3). Install two self-locking nuts (2) and flat washers (3). Install captivated capscrew (34) and flat washers (35). Install pressure relief valve (30), inner valve spring (31), outer valve spring (32) and valve cap (33) in pressure oil pump housing. Tighten cap and secure cap with locking wire. Install two preformed packings (1, fig. 3-203).

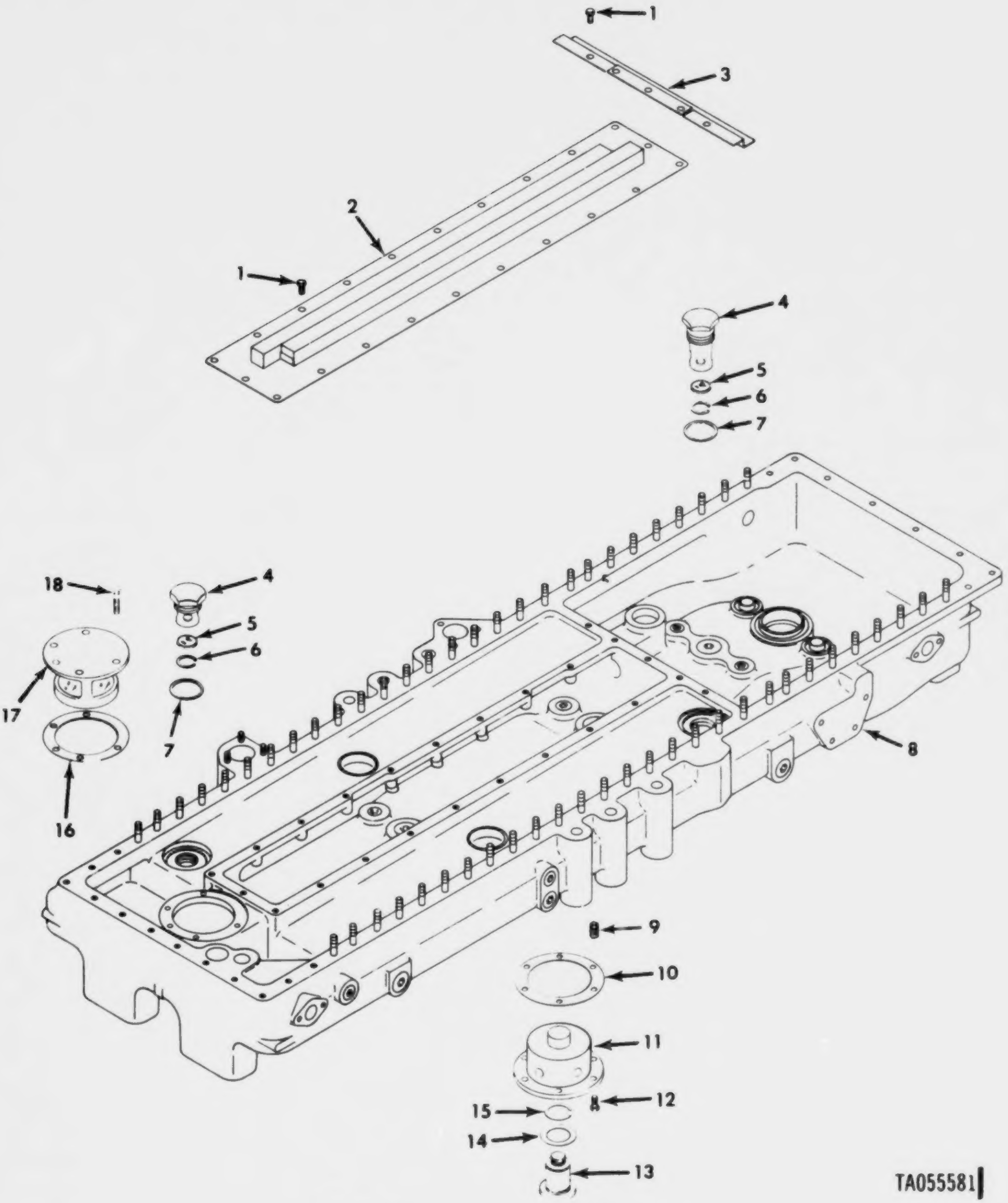
Section XI. REPAIR OF OIL PAN AND ASSOCIATED PARTS

3-80. General

This section covers the repair of the oil pan, oil pan reserve cover, plugs and associated parts. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations.

3-81. Disassembly

a. Remove 24 capscrews (1, fig. 3-204) and remove reserve cover (2) and bracket (3). Remove five capscrews (18) securing scavenge inlet screen (17) to oil pan (8). Remove scavenge inlet screen (17) and gasket (16). Discard gasket.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1 Capscrew	10 Gasket
2 Reserve cover	11 Drain plug adapter
3 Bracket	12 Capscrew
4 Adapter	13 Drain plug
5 Screen	14 Gasket
6 Retaining ring	15 Retaining ring
7 Gasket	16 Gasket
8 Oil pan	17 Scavenge inlet screen
9 Screw thread insert	18 Capscrew

Figure 3-204. Oil pan assembly, cover and associated parts – exploded view.

b. Remove drain plug (13), gasket (14), and retaining ring (15) from drain plug adapter (11). Discard gasket. Remove six capscrews (12) and remove drain plug adapter (11) and gasket (10). Discard gasket. Remove make-up oil pump adapters (4), screen (5), retaining rings (6) and gaskets (7). Discard gaskets.

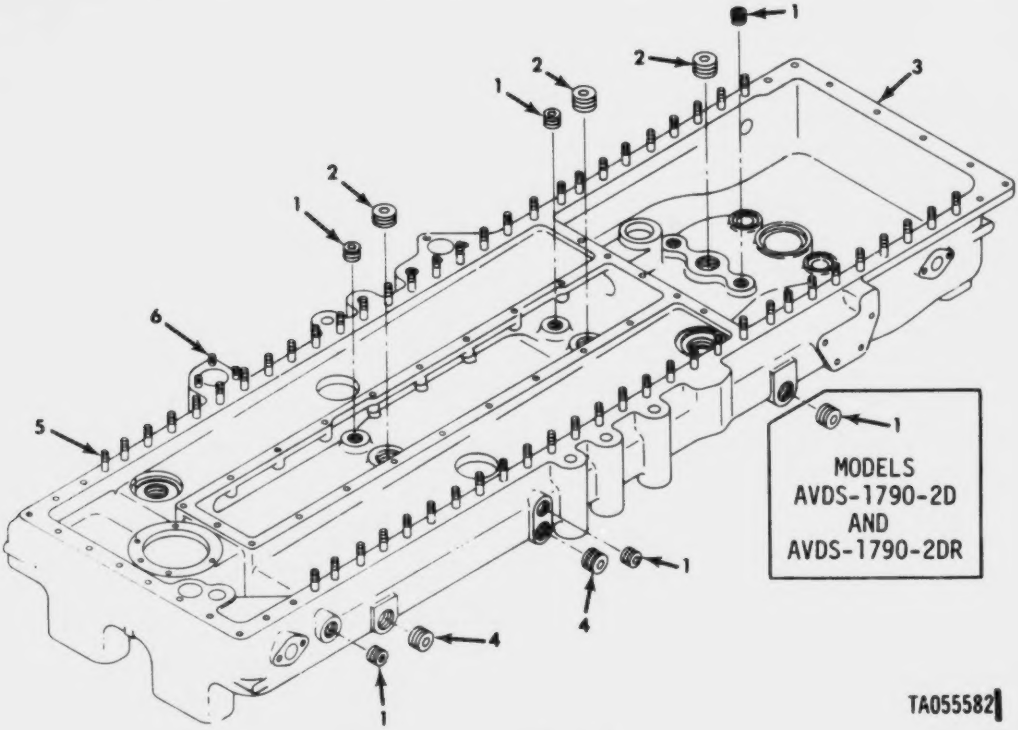
c. Remove three pipe plugs (2, fig. 3-205) and five pipe plugs (1) (six pipe plugs (1) in Model AVDS-1790-2D and AVDS-1790-2DR engines). Remove two pipe plugs (4).

3-82. Cleaning and Inspection

Refer to paragraph 3-36 and 3-37. The oil pan gasket flange must not be out of flat by more than 0.003 inch.

3-83. Repair

Refer to paragraph 3-38 and table 3-17 when replacing studs. Refer to paragraph 3-39 when replacing helical-coil and screw thread inserts.



1 Pipe plug
2 Pipe plug
3 Oil pan
4 Pipe plug
5 Stud
6 Stud

Figure 3-205. Oil pan pipe plugs – exploded view.

Table 3-17. Oil Pan Standard Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-205	6	25/32	3	5/16-18(3/4)x5/16-24(19/32)x1-7/16
3-205	5	1-11/32	56	3/8-16(15/16)x3/8-24(13/16)x2-3/32

3-84. Assembly

a. Install new gasket (10, fig. 3-204), drain plug adapter (11), and secure with six capscrews (12). Install new gasket (14) on drain plug (13) and secure with retaining ring (15). Install the assembled drain plug in the oil pan (8).

b. Install five pipe plugs (1, fig. 3-205) (six pipe plugs (1) on Models AVDS-1790-2D and AVDS-1790-2DR). Install three pipe plugs (2) and two pipe plugs (4).

c. Install new gasket (16, fig. 3-204), scavenge inlet screen (17) and secure with five capscrews (18). Install reserve cover (2), and bracket (3) and secure with 24 capscrews (1).

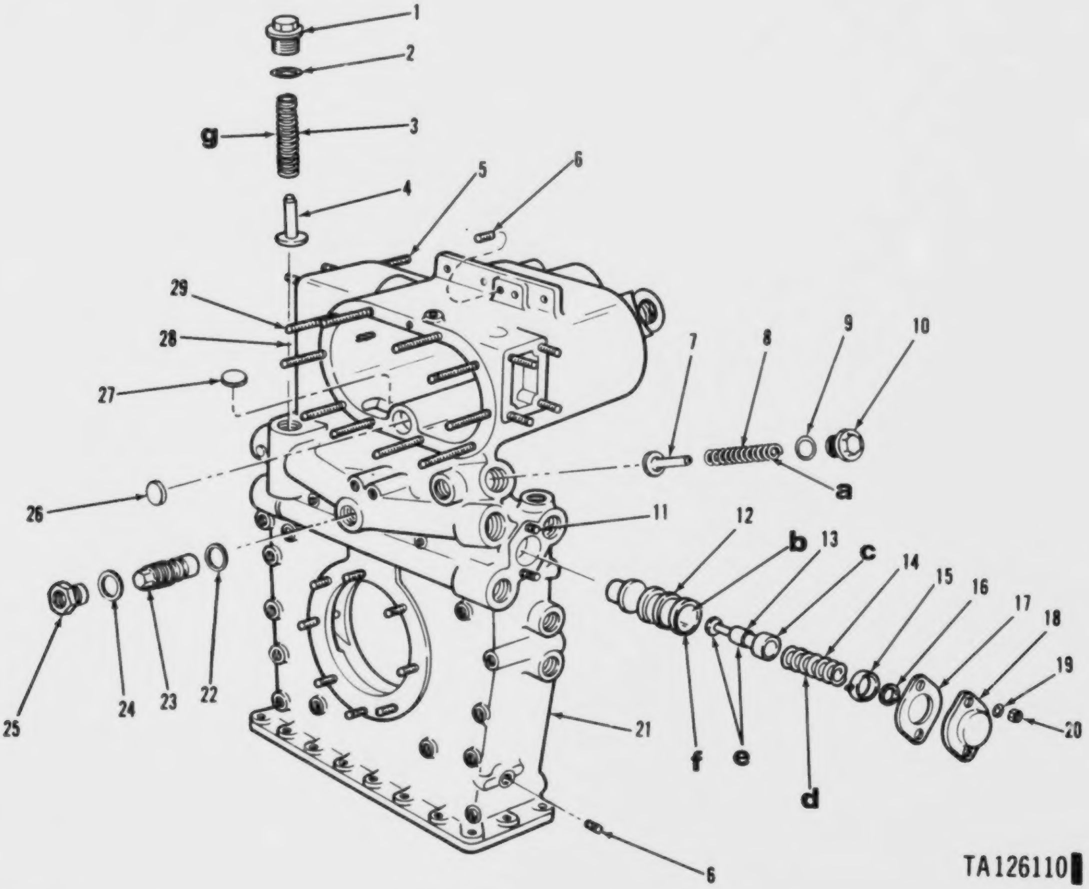
Section XII. REPAIR OF CRANKSHAFT DAMPER AND OIL FILTER HOUSING, OIL FILTERS, SWITCHES, AND TRANSMITTERS

3-85. General

This section covers the repair of the crankshaft damper and oil filter housing, oil cooler and oil filter bypass valves, oil pressure regulator valve, oil filters, switches, transmitters and associated parts. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedures.

3-86. Disassembly

a. Remove oil cooler bypass plunger plug (1, fig. 3-206). Remove and discard gasket (2). Remove oil cooler bypass valve plunger spring (3) and bypass plunger (4). Remove oil filter bypass plunger plug (10). Remove and discard gasket (9). Remove oil filter bypass valve plunger spring (8) and bypass valve plunger (7).



1 Oil cooler bypass plunger plug
2 Oil cooler bypass valve plunger gasket
3 Oil cooler bypass valve plunger spring
4 Oil cooler bypass valve plunger
5 Plain stud
6 Screw thread insert
7 Oil filter bypass valve plunger
8 Oil filter bypass valve plunger spring
9 Oil filter bypass valve plunger gasket
10 Oil filter bypass plunger plug
11 Plain stud
12 Oil pressure regulator valve sleeve
13 Oil pressure regulator valve plunger
14 Oil pressure regulator valve spring
15 Oil pressure regulator relief valve stop
16 Flat washer
17 Oil pressure regulator valve cover gasket
18 Oil pressure regulator valve access cover
19 Flat washer
20 Self-locking nut
21 Oil filter and damper housing
22 Preformed packing
23 Damper housing oil drain valve
24 Oil drain valve adapter gasket
25 Damper housing oil drain valve adapter
26 Expansion plug
27 Expansion plug
28 Screw thread insert
29 Plain stud

Figure 3-206. Damper housing, plungers, and associated parts.

WARNING

The oil pressure regulator valve cover is spring loaded. Exercise care when removing cover.

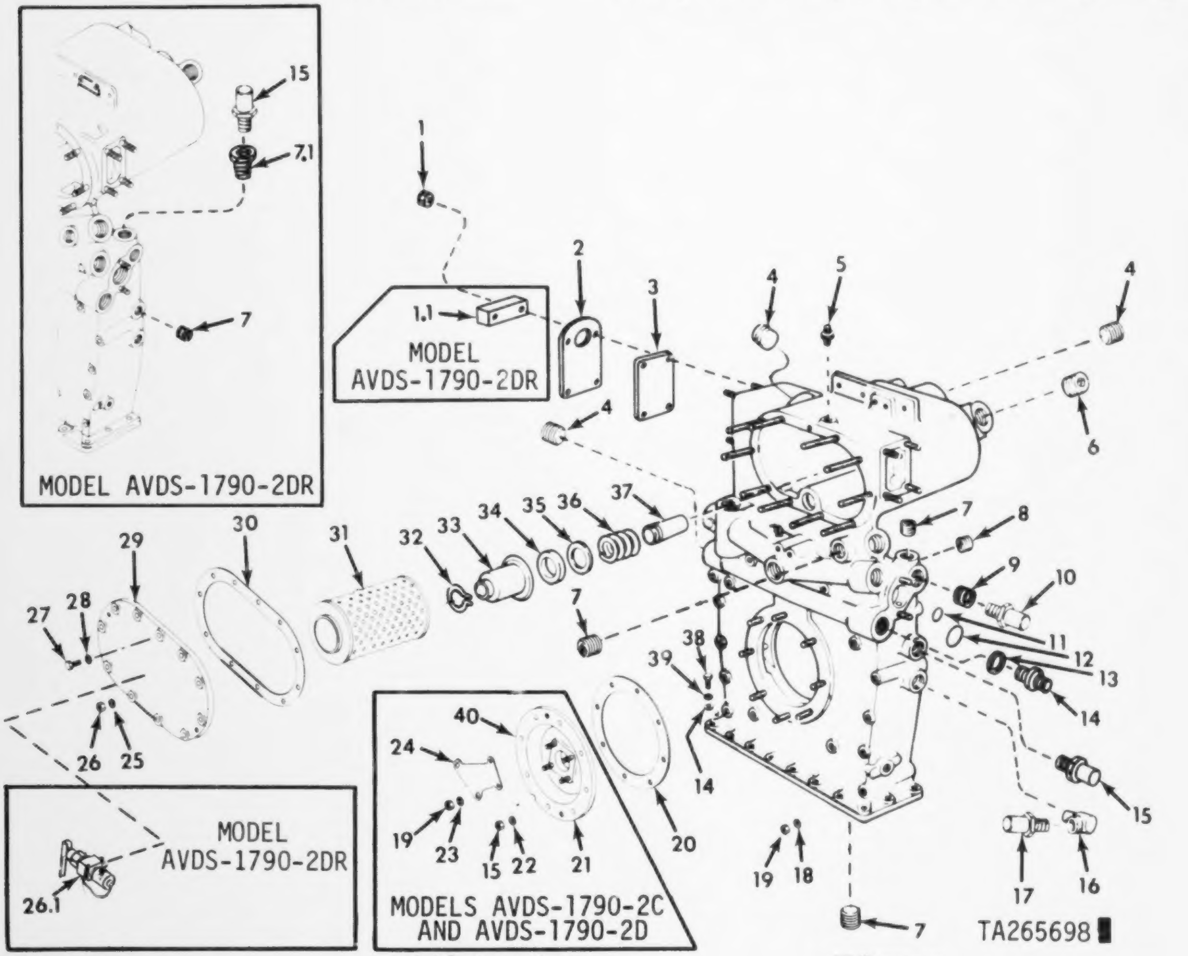
b. Remove two self-locking nuts (20) and flat washers (19) attaching oil pressure regulator valve cover to crankshaft damper and oil filter housing. Remove cover (18), gasket (17) and flat washers (16). Discard gasket. Remove valve stop (15), valve spring (14), valve plunger (13) and valve plunger sleeve (12).

NOTE

The valve sleeve plunger (12) may be difficult to remove because of the presence of varnish from the oil. An improvised tool (fig. 2-3), used with mechanical puller, Part No. 8708712, may be used to assist in removing valve sleeve (12). Insert hook end of tool into hole in sleeve and gently tap until sleeve is free.

c. Remove oil drain valve adapter (25) and oil drain valve adapter gasket (24). Discard gasket. Remove damper housing oil drain valve (23). Remove and discard preformed packing (22).

d. Remove oil filter cover air bleed hole capscrew (27, fig. 3-207) and packing (28). Discard packing.



1	Self-locking nut
1.1	Spacer
2	Lifting eye
3	Lifting eye gasket
4	Pipe plug
5	Oil cooler vent tube adapter
6	Pipe plug
7	Pipe plug
7.1	Bushing
8	Pipe plug
9	Reducer bushing
10	Oil temperature gage transmitter
11	Preformed packing
12	Preformed packing
13	Adapter gasket
14	Oil cooler hose adapter
15	Oil temperature switch
16	Elbow
17	Oil pressure warning switch
18	Flat washer
19	Self-locking nut
20	Fuel pump adapter gasket
21	Fuel pump adapter
22	Flat washer
23	Flat washer
24	Fuel pump check valve bracket
25	Flat washer
26	Self-locking nut
26.1	Oil sampling drain cock
27	Capscrew
28	Oil filter cover packing w/retainer
29	Oil filter cover
30	Oil filter cover gasket
31	Oil filter element
32	Oil filter support retaining ring
33	Oil filter element retainer
34	Oil filter element gasket
35	Oil filter spring seat
36	Oil filter element compression spring
37	Oil filter element support
38	Machine bolt
39	Lockwasher
40	Stud

Figure 3-207. Damper housing oil filter and associated parts — exploded view.

Remove ten self-locking nuts (26) and flat washers (25). Remove oil filter cover (29) using two puller screws (refer to paragraph 2-31). Remove and discard gasket (30). Remove oil filter elements (31). Remove oil filter retainer rings (32), retainers (33), gaskets (34), spring seats (35), compression springs (36), and supports (37). Discard oil filter elements and gaskets. Expansion plugs (26 and 27, fig. 3-206) should not be removed.

e. Remove two self-locking nuts and flat washers (fig. 3-208) attaching fuel backflow valve bracket and remove bracket. Remove six self-locking nuts and flat washers attaching fuel pump adapter. Remove adapter using two mechanical pullers Part No. 5739997. Remove and discard gasket.

***f.* Remove four oil cooler hose adapters (14, fig. 3-207) and gaskets (13). Discard gaskets. Remove pipe plugs (4, 6, 7, 8). Remove and discard preformed packings (11) and (12). Remove oil cooler vent tube adapter (5). Remove oil pressure warning switch (17), elbow (16) and oil temperature switch (15). Remove four self-locking nuts (1) spacer (1.1, model AVDS-1790-2DR engine), and remove two lifting eyes (2). Remove and discard lifting eye gasket (3). Remove oil temperature gage transmitter (10) and reducer bushing (9). Remove bushing (7.1, model AVDS-1790-2DR engine).**

NOTE

The lifting eye gasket is used under the left lifting eye only.

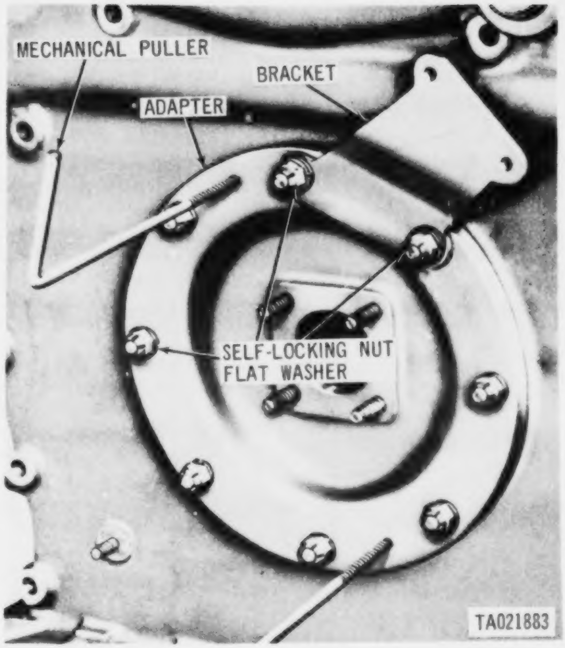


Figure 3-208. Removing or installing fuel pump adapter using mechanical pullers, model AVDS-1790-2C and AVDS-1790-2D engines.

3-87. Cleaning and Inspection

a. Cleaning. **Refer to paragraph 3-36. Make certain all oil passages (fig. 3-209) are clear and free of obstructions.**

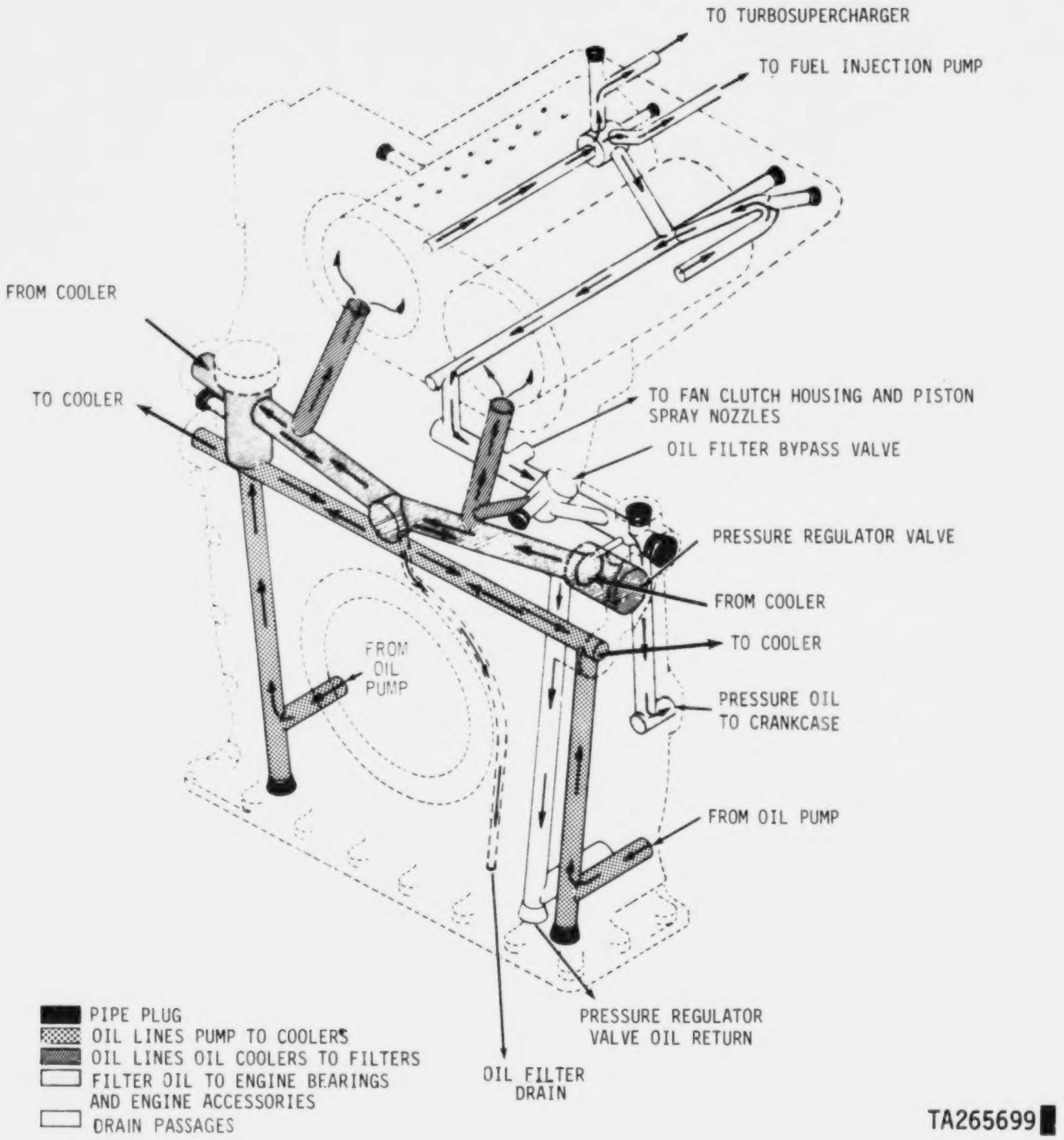

TO TURBOSUPERCHARGER
TO FUEL INJECTION PUMP
FROM COOLER
TO COOLER
TO FAN CLUTCH HOUSING AND PISTON SPRAY NOZZLES
OIL FILTER BYPASS VALVE
PRESSURE REGULATOR VALVE
FROM COOLER
TO COOLER
FROM OIL PUMP
PRESSURE OIL TO CRANKCASE
FROM OIL PUMP
PRESSURE REGULATOR VALVE OIL RETURN
OIL FILTER DRAIN
PIPE PLUG
OIL LINES PUMP TO COOLERS
OIL LINES OIL COOLERS TO FILTERS
FILTER OIL TO ENGINE BEARINGS AND ENGINE ACCESSORIES
DRAIN PASSAGES
TA265699

Figure 3-209. Crankshaft damper and oil filter housing oil passages.

b. Inspection. Refer to paragraph 3-37. Inspect the oil temperature warning switch and oil temperature transmitter switch for damaged threads or deformity. Inspect oil pressure regulator plunger spring (14, fig. 3-206) and sleeve (12) against limits specified in repair standards (table 3-18). Inspect oil cooler plunger spring (3) and oil filter plunger spring (8) against limits specified in repair standards (table 3-18).

Table 3-18. Crankshaft Damper and Oil Filter Housing Control Valves — Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and Fits of new parts		Wear limits
Oil pressure regulator plunger.	3-206	b	Inside diameter of sleeve (small)	0.8125	0.8135	0.8145
		e	Outside diameter of plunger (small)	0.8095	0.8105	0.8085
		b-e	Fit of plunger in sleeve (small)	0.0020L	0.0040L	0.0060L
	3-206	f	Inside diameter of sleeve (large)	1.1865	1.1885	1.1905
		c	Outside diameter of plunger (large)	1.1840	1.1850	1.1830
		f-c	Fit of plunger in sleeve (large)	0.0015L	0.0045L	0.0075L
		d	Valve spring:			
			Approximate free length of spring.	2.83 inch		•
			Scale reading at 1.825 inch length.	29.3 lb ± 3 lb		•
			Maximum solid height.	1.284 inch		•
Oil filter pressure relief bypass valve spring	3-206	a	Bypass valve spring:			
			Approximate free length of spring.	4.28 inch		•
			Scale reading at 2.81 inch length.	52.3 lb ± 5 lb		•
			Maximum solid	2.261 inch		•
	3-206	g	Bypass valve spring:			
			Approximate free length of spring.	3.38 inch		•
			Scale reading at 2.838 inch length.	178.2 lb. ± 9 lb.		•
			Maximum solid height.	2.404 inch		•

Refer to paragraph 3-37c for explanation of symbols.

3-88. Repair

Refer to paragraph 3-38*d* and table 3-19 when replacing studs. Refer to paragraph 3-39 when replacing helical coil and screw thread inserts.

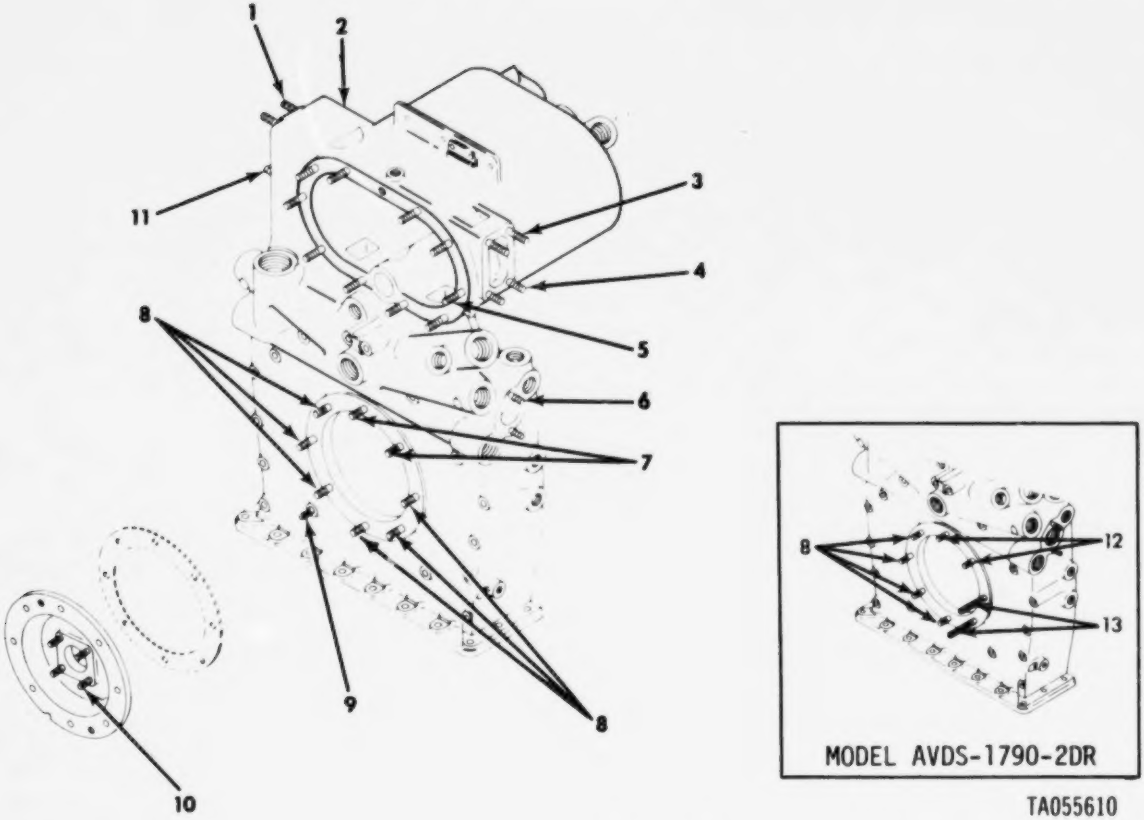


Figure 3-210. Crankshaft damper and oil filter housing studs.

Table 3-19. Crankshaft Damper and Oil Filter Housing Standard Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-210	1	1-1/4	2	3/8-16 (15/16) x 3/8-24 (13/16) x 1-15/16
3-210	2	25/32	2	5/16-18 (11/16) x 5/16-24 (9/16 x 1-5/16
3-210	3	1-7/16	2	3/8-16 (15/16) x 3/8-24 (13/16) x 2-3/32
3-210	4	1-3/32	2	3/8-16 (27/32) x 3/8-24 (7/8) x 1-3/4
3-210	5	1-13/32	10	3/8-16 (15/16) x 3/8-24 (13/16) x 2-3/32
3-210	6	27/32	2	5/16-18 (3/4) x 5/16-24 (19/32) x 1-1/2
3-210	7	1-3/16	2	3/8-16 (7/8) x 3/8-24 (15/16) x 1-3/4
3-210	8	1-1/16	6	3/8-16 (7/8) x 3/8-24 (15/16) x 1-3/4
3-210	9	13/16	1	3/8-16 (3/4) x 3/8-24 (9/16) x 1-13/32
3-210	10	15/16	4	3/8-16 (13/16) x 3/8-24 (11/16) x 1-5/8
3-210	11	7/8	4	5/16-18 (3/4) x 5/16-24 (19/32) x 1-1/2
3-210	12	1-1/16	2	3/8-16(7/8) x 3/8-24 (27/32) x 1-3/4
3-210	13	4-1/16	2	3/8-16 (13/16) x 3/8-24 (15/16) x 4-11/16

3-89. Assembly

a. Install lifting eye gasket (3, fig. 3-207), two lifting eyes (2), spacer (1.1, model AVDS-1790-2DR engine), and secure with four self-locking nuts (1). Install oil temperature transmitter (15) and oil temperature warning switch elbow (16) and switch (17). Install bushing (7.1, model AVDS-1790-2DR engine) and oil temperature transmitter (15). Install oil cooler vent tube adapter (5). Install new preformed packings (11) and (12). Install pipe plugs (4, 6, 7 and 8). Install four new oil cooler hose adapter gaskets (13) and adapters (14). Install oil temperature gage transmitter reducer bushing (9) and transmitter (10).

b. Install new fuel pump adapter gasket (20) and fuel pump adapter (21) and secure with six self-locking nuts and flat washers. Install fuel check valve bracket and secure with two self-locking nuts and flat washers. Install two oil filter element supports (37), compression springs (36), spring seats (35), gaskets (34), retainers (33) and secure with retainer rings (32). Install two new oil filter elements (31). Install new oil filter cover gasket (30). Install oil filter cover (29) and secure with ten self-locking nuts (26) and flat washers (25). Install new oil filter packing (28) and capscrew (27).

c. Install new preformed packing (22, fig. 3-206) on damper housing oil drain valve (23) and install valve in adapter. Install new drain valve adapter gasket (24) on oil drain valve adapter (25) and install adapter.

d. Install valve plunger sleeve (12), valve plunger (13), spring (14) and stop (15). Install flat washers (16) and new gasket (17), cover (18) and secure with two self-locking nuts (20) and flat washers (19). Install oil cooler bypass valve plunger (4). Position bypass valve spring (3), on valve plunger and install plug (1) using new gasket (2). Install oil filter bypass valve plunger (7). Position bypass valve spring (8) on valve plunger (7) and install plug (10) using new gasket (9).

Section XIII. REPAIR OF FRONT FAN DRIVE HOUSING AND CLUTCH ASSEMBLY

3-90. General

This section covers the repair of the front fan drive housing and clutch assembly. Specific instructions on disassembly, cleaning, inspection, repair and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedures. Stud identification tables are included where applicable.

3-91. Disassembly

a. Front Drive Housing and Cover.

(1) Cut locking wire (1, fig. 3-211) and remove six drilled head bolts and flat washers (2) attaching fan drive oil seal housing (3) to fan drive housing cover (4). Install two mechanical pullers, Part No. 5739997, in puller screw holes (5) and turn screws alternately to remove housing. Remove and discard gasket (6).

NOTE

Remove eight slotted nuts from front fan drive housing cover, four nuts were removed during removal of two fuel injector tube brackets. Remove four slotted nuts from rear fan drive housing cover, eight nuts were removed during removal of four injector tube brackets.

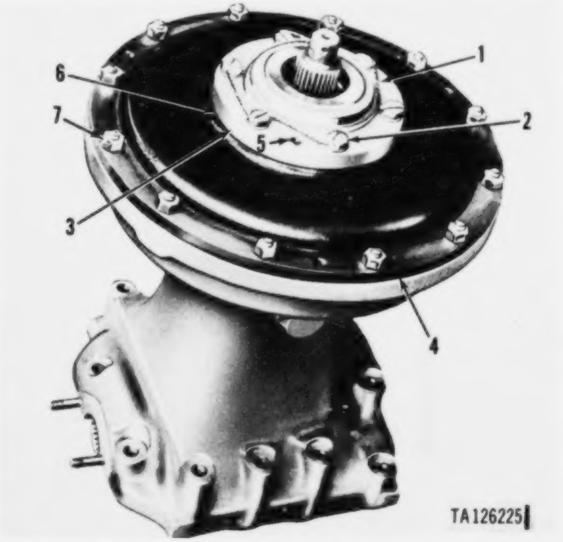
(2) Remove slotted nuts (7) attaching fan drive housing cover (4) to fan drive housing assembly. Install three drilled head bolts (2), used to secure fan drive oil seal housing, and using bolts as puller screws, remove fan drive clutch and cover from front fan drive housing assembly.

(3) Using a suitable puller, separate clutch cover and bearing assembly from clutch assembly (fig. 3-213) and remove and discard preformed packing (7, fig. 3-212).

(4) Use a suitable arbor and an arbor press to remove clutch upper ball bearing from housing cover as shown in figure 3-214.

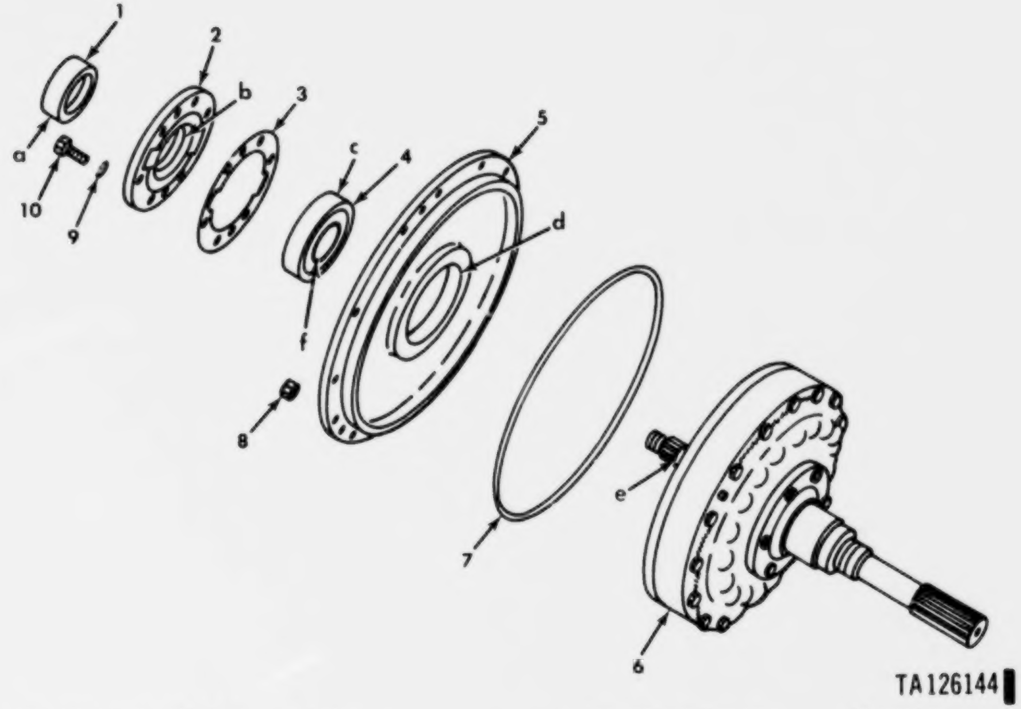
(5) Remove vertical drive shaft oil seal (fig. 3-215) from fan drive oil seal housing.

(6) Remove four cotter pins (18, fig. 3-216) and slotted nuts (7) and remove the assembled fan drive bevel gearshaft, bearings and supports from fan drive housing (2). Remove bearing support (16) from front gearshaft ball bearing (19) and bearing support (35) from rear gearshaft ball bearing (22).



1 Locking wire
2 Drilled head bolt and flat washer
3 Fan drive oil seal housing
4 Fan drive housing cover
5 Puller screw hole
6 Gasket
7 Slotted nut

Figure 3-211. Removing or installing fan drive oil seal housing and fan drive clutch and cover.


1
2
b
3
5
a
10
9
c
4
d
f
8
7
e
6
TA126144

1 Fan drive vertical shaft oil seal
2 Fan drive oil seal housing
3 Gasket
4 Fan drive clutch upper ball bearing
5 Fan drive housing cover
6 Fan drive clutch assembly
7 Preformed packing
8 Slotted nut
9 Flat washer
10 Drilled head bolt

Figure 3-212. Fan drive clutch and cover assembly – exploded view.

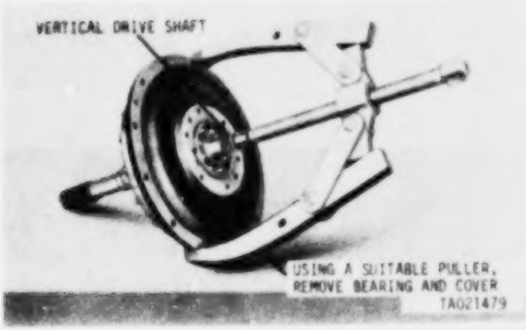

VERTICAL DRIVE SHAFT
USING A SUITABLE PULLER, REMOVE BEARING AND COVER
TA021479

Figure 3-213. Removing clutch cover and bearing assembly from clutch assembly using puller.

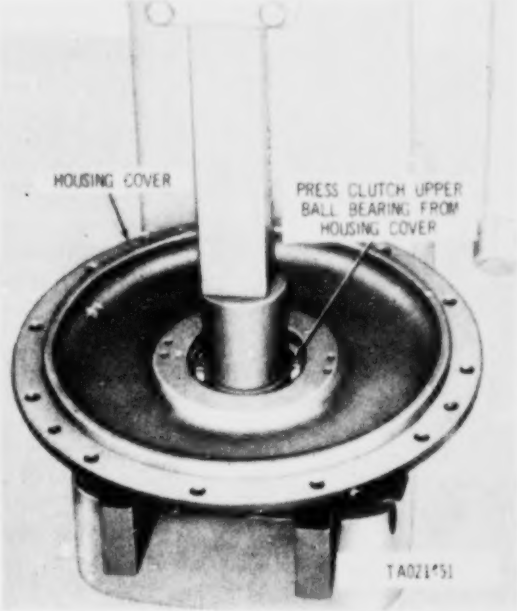

HOUSING COVER
PRESS CLUTCH UPPER BALL BEARING FROM HOUSING COVER
TA021[illegible]51

Figure 3-214. Removing fan drive clutch upper ball bearing from housing cover.

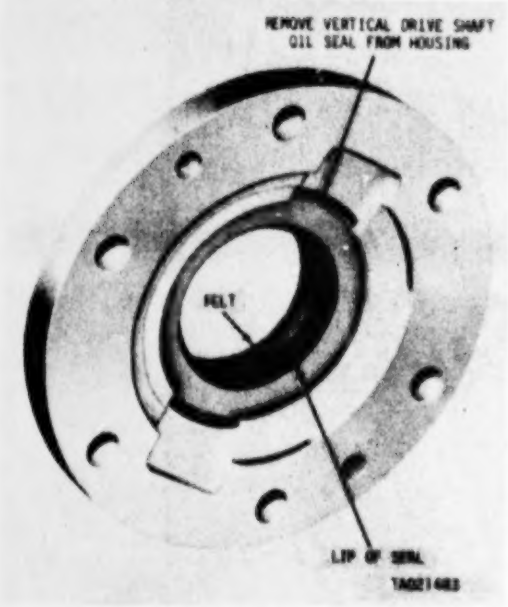
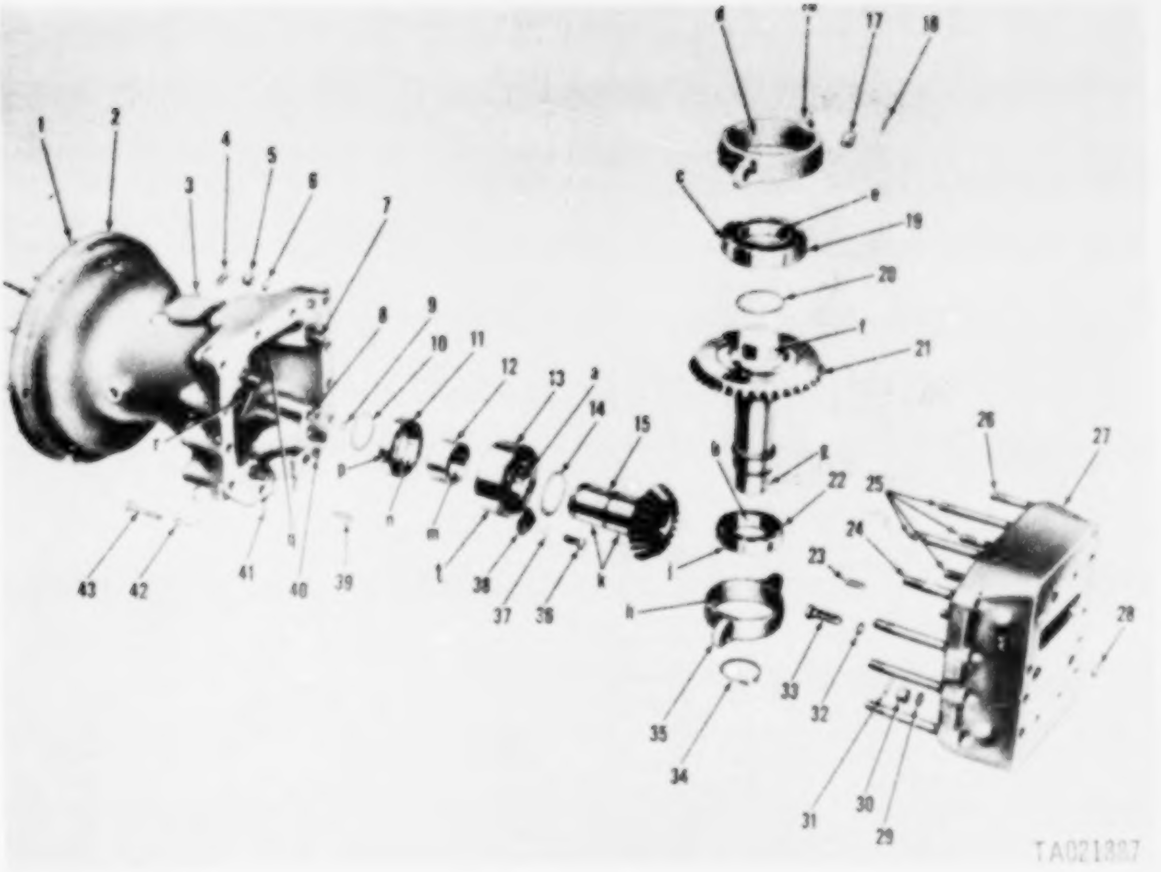

REMOVE VERTICAL DRIVE SHAFT OIL SEAL FROM HOUSING
FELT
LIP OF SEAL
TA021483

Figure 3-215. Removing fan vertical drive shaft oil seal.

Remove retaining ring (34) securing rear gearshaft bearing on fan drive bevel gearshaft (21). Press fan drive bevel gearshaft from front bevel gearshaft ball bearing (fig. 3-217). Remove and retain shim or shims (20, fig. 3-216) for use during assembly. Press fan drive bevel gearshaft from rear gearshaft ball bearing (fig.3-217) in the same manner.



1 Fan drive housing cover studs
2 Front cooling fan drive housing
3 Throttle lever shaft bracket studs
4 Oil port pipe plug
5 Self-locking hex nut
6 Flat washer
7 Fan drive shaft gear bearing support studs
8 Fan drive housing base oil transfer tube
9 Fan drive housing base oil transfer tube preformed packing
10 Fan drive driven bevel gearshaft retaining ring
11 Fan drive driven bevel gearshaft ball bearing
12 Fan drive driven bevel gearshaft spacer
13 Fan drive driven bevel gearshaft inner ball bearing
14 Fan drive driven bevel gearshaft shims
15 Fan drive driven bevel gearshaft
16 Fan drive gearshaft bearing support
17 Slotted hex nut
18 Cotter pin
19 Fan drive bevel gearshaft ball bearing
20 Fan drive bevel gearshaft shims
21 Fan drive bevel gearshaft
22 Fan drive bevel gearshaft ball bearing
23 Front fan drive housing base inserts
24 Front fan drive housing base to housing studs
25 Front fan drive housing base to housing studs
26 Front fan drive housing base to housing studs
27 Front fan drive housing base
28 Crankcase to fan drive housing base oil transfer tube preformed packing
29 Flat washer
30 Slotted hex nut
31 Cotter pin
32 Flat washer
33 Hex head capscrew
34 Fan drive bevel gearshaft retaining ring
35 Fan drive bevel gearshaft bearing support
36 Machine bolt
37 Key washer
38 Bearing retaining plate
39 Fan drive bevel gearshaft support insert
40 Front fan drive housing base dowel pin
41 Inter-fan driveshaft cover adapter studs
42 Flat washer
43 Hex head capscrew

Figure 3-216. Front fan drive and mounting base — exploded view.

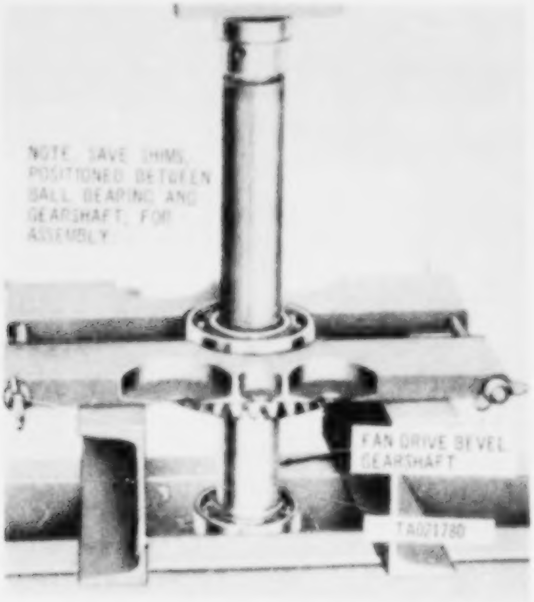

NOTE: SAVE SHIMS, POSITIONED BETWEEN BALL BEARING AND GEARSHAFT, FOR ASSEMBLY.
FAN DRIVE BEVEL GEARSHAFT
TA021780

Figure 3-217. Removing fan drive bevel gearshaft ball bearings.

(7) Straighten tab on key washer (37, fig. 3-216) and remove bolt (36), washer, and lock plate (38) securing fan driven gearshaft assembly in front fan drive housing (2), and discard washer. Remove assembled fan driven gearshaft, lower driven gearshaft ball bearing, and bearing spacer.

(8) Remove retaining ring (10) securing gearshaft bearing (11) on fan driven bevel gearshaft (15). Press fan driven gearshaft from gearshaft ball bearing (fig. 3-218) and remove spacer (12, fig. 3-216) and press fan driven gearshaft (fig. 3-219) from gearshaft inner ball bearing (13, fig. 3-216). Remove and retain shims (14, fig. 3-216), positioned between gearshaft and ball bearing for assembly.

b. Clutch Assembly.

(1) Cut locking wire and remove sixteen bolts (10, fig. 3-220) attaching fan drive hub (9) to assembled clutch flange (1). Remove assembled clutch flange and disc housing (2). Remove two fan drive clutch discs (3 and 5) and two fan driven clutch discs (4 and 6).

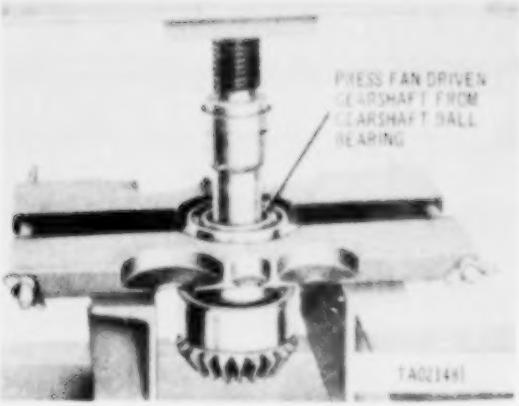

PRESS FAN DRIVEN GEARSHAFT FROM GEARSHAFT BALL BEARING
TA021481

Figure 3-218. Pressing fan driven gearshaft from upper gearshaft ball bearing.

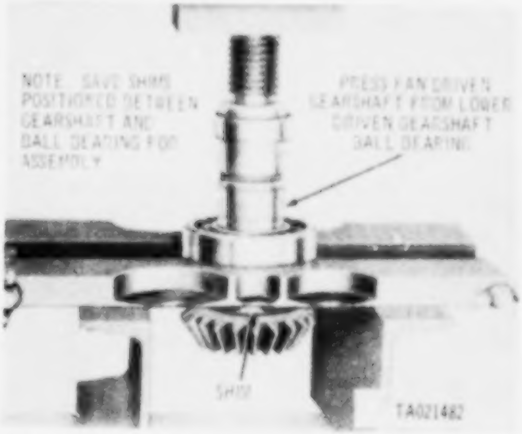
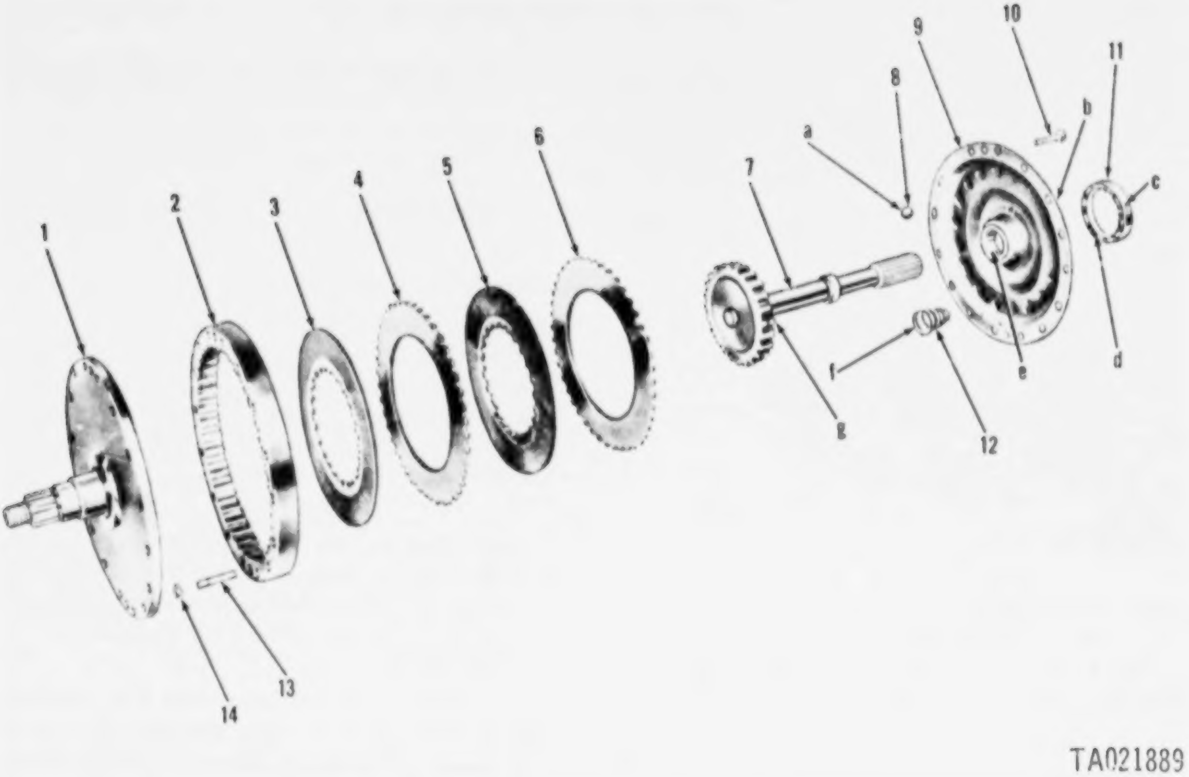

NOTE: SAVE SHIMS POSITIONED BETWEEN GEARSHAFT AND BALL BEARING FOR ASSEMBLY
PRESS FAN DRIVEN GEARSHAFT FROM LOWER DRIVEN GEARSHAFT BALL BEARING
SHIM
TA021482

Figure 3-219. Pressing fan driven gearshaft from lower driven gearshaft ball bearing.



1 Fan drive clutch flange
2 Fan drive clutch disc housing
3 Fan drive clutch disc
4 Fan drive clutch disc
5 Fan drive clutch disc
6 Fan drive clutch disc
7 Fan drive vertical shaft assembly
8 Ball bearings
9 Fan drive hub assembly
10 Machine bolt
11 Fan drive vertical outer annular ball bearing
12 Fan drive clutch compression springs
13 Dowel pin
14 Retaining ring

Figure 3-220. Fan drive clutch assembly — exploded view.

(2) Remove fan drive vertical shaft (fig. 3-221) from hub and remove three clutch springs and fifteen ball bearings.

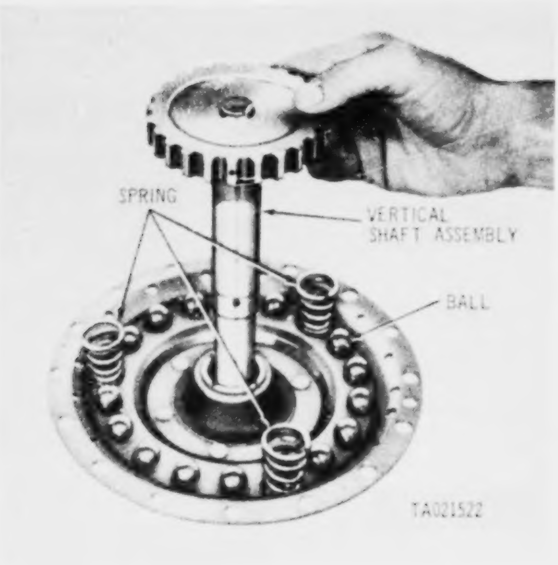


Figure 3-221. Removing or installing fan drive vertical drive shaft, balls, and springs from fan drive hub.

(3) Support outer ball bearing (fig. 3-222) and press drive hub (9, fig. 3-220) from ball bearing.

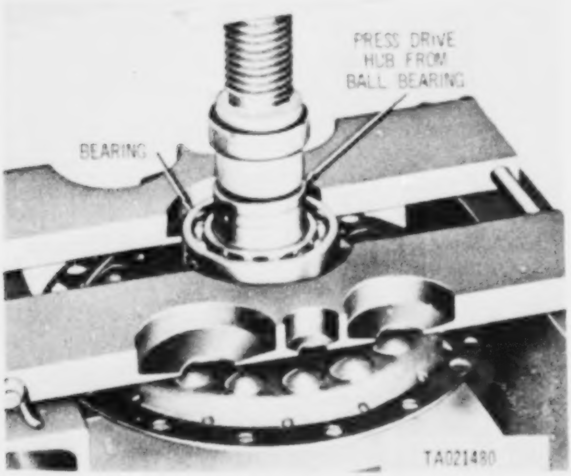


Figure 3-222. Removing or installing ball bearing from drive hub.

(4) Separate fan drive clutch flange (1) from disc housing (2).

NOTE

Do not remove the dowel pins (13, fig. 3-220) and retaining rings (14) from disc housing unless inspection (para 3-93*c*) indicates replacement is necessary. Use a suitable arbor press to remove dowel pins from housing.

3-92. Cleaning

Refer to paragraph 3-36.

3-93. Inspection and Repair

a. General. Refer to paragraph 3-37 and 3-38.

b. Fan Driven Gearshaft and Fan Driven Bevel Gearshaft. Inspect fan driven gearshaft (21, fig. 3-216) and fan driven bevel gearshaft (15) to limits specified in repair standards (table 3-21).

NOTE

If either the fan driven gearshaft or fan drive bevel gearshaft require replacement, both must be replaced as they are a matched gear set and cannot be replaced individually.

c. Oil Seals. Refer to paragraphs 3-37 and 3-38.

d. Ball Bearings. Refer to paragraphs 3-37 and 3-38.

e. Housing Assemblies. Inspect fan drive clutch disc housing (2, fig. 3-220) cooling fan drive housing (2, fig. 3-216), and fan drive housing base (27) for loose dowel pins and oil transfer tubes if applicable.

f. Clutch Compression Springs and Balls. Inspect clutch compression springs (12, fig. 3-220) for weakness, broken coils, and distorted condition. Check balls (8) and springs to limits specified in repair standards (table 3-20).

g. Drive Hub. Inspect fan drive hub (9) for raised metal, loose rivets, warpage or pitted surfaces caused by ball wear. Check bearing surfaces against limits specified in repair standards (tables 3-21). Repair metal surfaces by polishing pitted areas smooth.

h. Clutch Discs. Inspect clutch discs (3, 4, 5 and 6, fig. 3-220) for cracks, warpage, wear or other abrasive damage. Inspect for excessive heat distortion. Clutch discs cannot be repaired. Replace discs if any of the above mentioned is evident.

Table 3-20. Cooling Fan Clutch Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Cooling fan clutch	3-220	g	Outside diameter of fan drive vertical shaft.	1.1450	1.1460	1.1440
	3-220	e	Inside diameter of fan clutch hub.	1.1470	1.1480	1.1490
	3-220	g-e	Fit of shaft in hub bearing.	0.0010L	0.0030L	0.0050L
	3-220	a	Spherical diameter of clutch balls.	0.6240	0.6260	*

See foot note at end of table.

Table 3-20. Cooling Fan Clutch Repair Standards — Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Cooling fan clutch	3-220	f	Spring helical compression:			*
			Approximate free length.	1.19 inch		*
			Scale reading at 0.807 inch.	31 lb to 39 lb		
			Maximum solid height.	0.607 inch		

Refer to paragraph 3-37*c* for explanation of symbols.

Table 3-21. Front Fan Drive Housing Assembly Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Front fan drive housing	3-216	r	Inside diameter (small) of liner in front fan drive housing.	2.6772	2.6779	2.6782
	3-216	p	Outside diameter of bearing.	2.6767	2.6772	*
	3-216	p-r	Fit of bearing in liner.	0.0000	0.0012L	0.0015L
	3-216	q	Inside diameter (large) of liner in front fan drive housing.	3.1496	3.1503	3.1506
	3-216	t	Outside diameter of bearing.	3.1491	3.1496	*
	3-216	t-q	Fit of bearing of liner.	0.0000	0.0012L	0.0015L
	3-216	n	Inside diameter of bearing.	1.5743	1.5748	*
	3-216	k	Outside diameter of bearing surface on gearshaft.	1.5749	1.5753	1.5747
	3-216	n-k	Fit of bearing on gearshaft.	0.0001T	0.0010T	0.0001L
	3-216	m	Inside diameter of spacer.	1.5800	1.5850	1.5950
	3-216	m-k	Fit of spacer on gearshaft.	0.0047L	0.0101L	0.0203L
	3-216	a	Inside diameter of bearing.	1.5743	1.5748	*
	3-216	a-k	Fit of bearing on gearshaft.	0.0001T	0.0010T	0.0001L
	3-216	d	Inside diameter of bearing support.	3.1495	3.1501	3.1504
	3-216	c	Outside diameter of bearing.	3.1491	3.1496	*
	3-216	c-d	Fit of bearing in bearing support.	0.0010L	0.0001T	0.0013L
	3-216	e	Inside diameter of bearing.	1.5743	1.5748	*
	3-216	f	Outside diameter of bearing surface on gearshaft.	1.5749	1.5753	1.5747
	3-216	e-f	Fit of bearing on gearshaft.	0.0001T	0.0010T	0.0001L
	3-216	b	Inside diameter of bearing.	1.5743	1.5748	*
	3-216	g	Outside diameter of bearing surface on gearshaft.	1.5749	1.5753	1.5747
	3-216	b-g	Fit of bearing on gearshaft.	0.0001T	0.0010T	0.0001L
	3-216	j	Outside diameter of bearing.	2.6767	2.6772	*
	3-216	h	Inside diameter of bearing support.	2.6771	2.6777	2.6780
	3-216	j-h	Fit of bearing in bearing support.	0.0010L	0.0001T	0.0013L
	3-220	d	Inside diameter of bearing.	1.7712	1.7717	*
	3-220	b	Outside diameter of bearing surface on clutch hub.	1.7718	1.7722	1.7716
	3-220	d-b	Fit of bearing on clutch hub.	0.0001T	0.0010T	0.0001L
	3-220	C	Outside diameter of bearing.	2.9523	2.9528	*
	3-216	s	Inside diameter of liner in fan drive housing.	2.9528	2.9535	2.9538
	3-220 3-216	c s	Fit of bearing in fan drive housing liner.	0.0000	0.0012L	0.0015L
	3-212	e	Outside diameter of bearing surface on clutch shaft.	1.3781	1.3785	1.3779
	3-212	f	Inside diameter of bearing.	1.3775	1.3780	*
	3-212	f-e	Fit of bearing on shaft.	0.0001T	0.0010T	0.0001L
	3-212	d	Inside diameter of bearing bore in fan drive housing cover.	3.1496	3.1503	3.1506
	3-212	c	Outside diameter of bearing.	3.1491	3.1496	*
	3-212	c-d	Fit of bearing in cover.	0.0000	0.0012L	0.0015L

See foot note at end of table.

Table 3-21. Front Fan Drive Housing Assembly Repair Standards — Continued

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts		Wear limits
Front fan drive housing	3-212	b	Inside diameter of fan drive oil seal housing.	2.6220	2.6240	*
	3-212	a	Outside diameter of oil seal.	2.6260	2.6300	*
	3-212	a-b	Fit of oil seal in housing.	0.0020T	0.0080T	*

Refer to paragraph 3-37c for explanation of symbols.

i. Studs. Refer to paragraph 3-38*d*, table 3-22 and figure 3-223 when replacing studs.

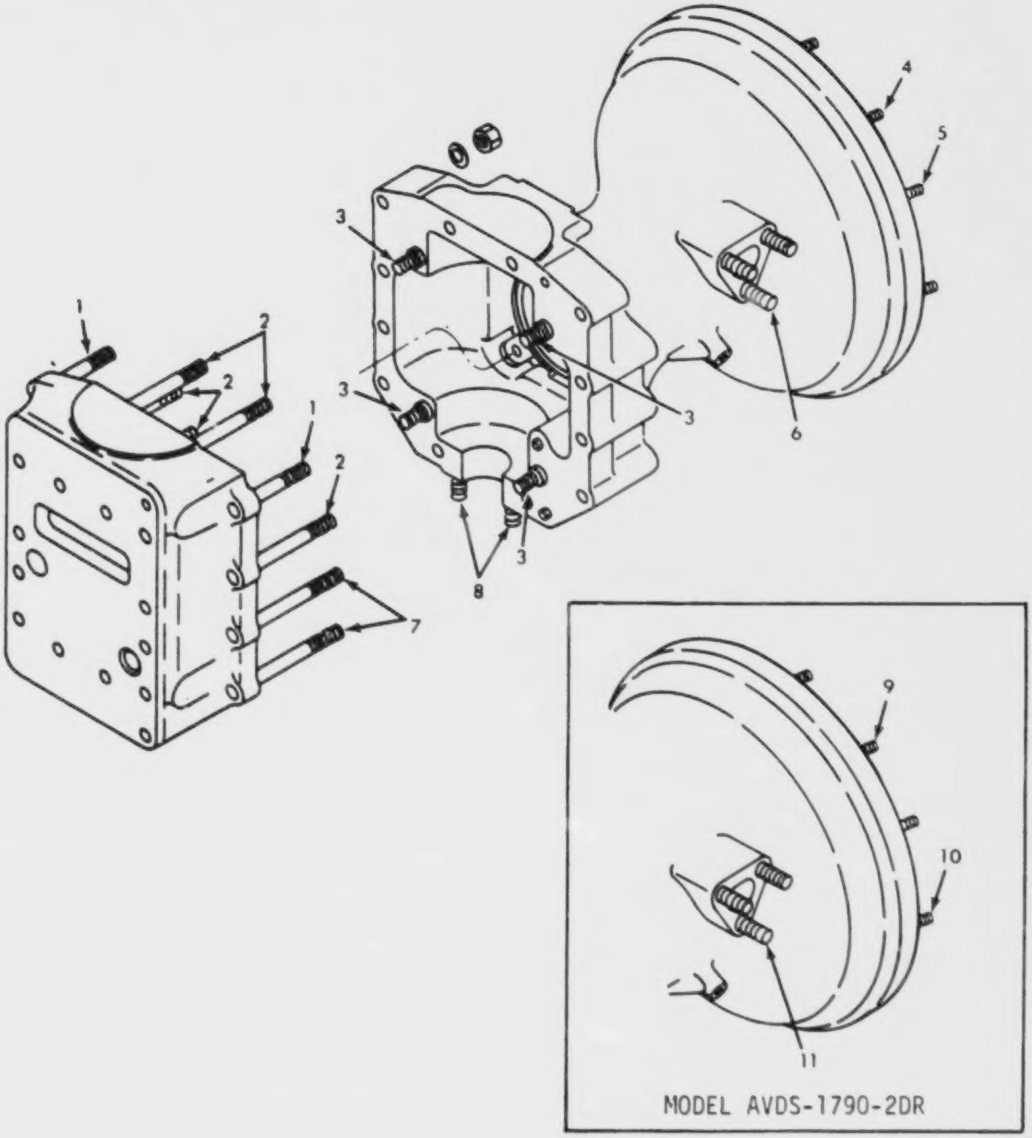


Figure 3-223. Front fan drive housing and mounting base studding assembly.

Table 3-22. Front Fan Drive Housing Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-223	1	2-1/16	2	3/8-16 (51/64) x 3/8-24 (7/8) x 2-25/32
3-223	2	3-1/16	6	3/8-16 (51/64) x 3/8-24 (11/16) x 3-7/8
3-223	3	3/4	4	3/8-16 (13/16) x 3/8-24 (3/4) x 1-7/8
3-223	4	23/32	8	5/16-18 (3/4) x 5/16-24 (19/32) x 1-7/16
3-223	5	29/32	4	5/16-18 (3/4) x 5/16-24 (19/32) x 1-3/4
3-223	6	7/8	3	5/16-15 (3/4) x 5/16-24 (19/32) x 1-1/2
3-223	7	1 (throttle bracket)	2	5/16-18 (3/4) x 5/16-24 (19/32) x 1-1/2
3-223	8	3-1/2	2	3/8-16 (27/32) x 3/8-24 (11/16) x 4-5/16
3-223	9	25/32	8	5/16-18 (19/32) x 5/16-24 (3/4) x 1-7/16
3-223	10	29/32	4	5/16-18 (3/4) x 5/16-24 (13/16) x 1-9/16
3-223	11	1-21/32	3	5/16-18 (3/4) x 5/16-24 (3/4) x 2-5/16

3-94. Assembly

a. Clutch Assemblies.

(1) Install dowel pin (13, fig. 3-220) and retaining ring (14) in disc housing (2) and install clutch flange (1) on disc housing.

(2) Support drive hub (9, fig. 3-220) and press outer ball bearing (11) on drive hub using a suitable hollow tool the size of the inner race.

(3) Place a dab of grease, MIL-G-10924, in each ball pocket to facilitate keeping balls in proper location during assembly. Install fan drive vertical shaft assembly in the fan drive hub. Position fifteen clutch balls (fig. 3-221) and three clutch springs in the fan drive hub.

(4) Install a fan driven clutch disc (6, fig. 3-220), drive clutch disc (5), driven clutch disc (4), and a drive clutch disc (3) on clutch springs (12) in hub assembly (9), and install assembled clutch disc housing (2) and clutch flange (1). Secure assembled disc housing and clutch flange to fan drive hub assembly with sixteen bolts (10) and install locking wire.

b. Front Drive Housing and Cover.

(1) Determine end play for fan drive gearshaft. Position original shims (14, fig. 3-216) on end of inner bearing race (side opposite bearing trade mark) of lower driven gearshaft ball bearing (13). Measure the total thickness of bearing race and shim, from shim on inner race to upper face of outer race, with end play removed. Thickness must be from 1.2635 inch minimum to 1.2655 inch maximum. When total thickness is greater than 1.2655 inch, strip 0.002 inch thick laminations from shim pack until the correct thickness is obtained. When total thickness is less than 1.2635 inch, add 0.002 inch thick shims (stripped from a new shim pack Part No. 8622455) as necessary. Figure 3-224 illustrates shim location and measuring points.

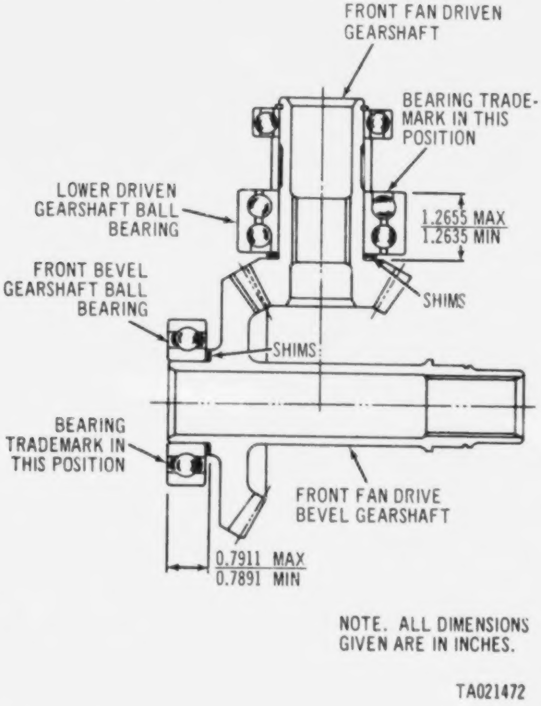

FRONT FAN DRIVEN GEARSHAFT
BEARING TRADE-MARK IN THIS POSITION
LOWER DRIVEN GEARSHAFT BALL BEARING
1.2655 MAX
1.2635 MIN
FRONT BEVEL GEARSHAFT BALL BEARING
SHIMS
SHIMS
BEARING TRADEMARK IN THIS POSITION
FRONT FAN DRIVE BEVEL GEARSHAFT
0.7911 MAX
0.7891 MIN
NOTE. ALL DIMENSIONS GIVEN ARE IN INCHES.
TA021472

Figure 3-224. Determining shim thickness for front fan drive gearshaft and driven bevel gearshaft.

(2) Position shim (fig. 3-225) of predetermined thickness (fig. 3-224) on inner race of lower driven gearshaft ball bearing (fig. 3-225) and press fan driven gearshaft into ball bearing.

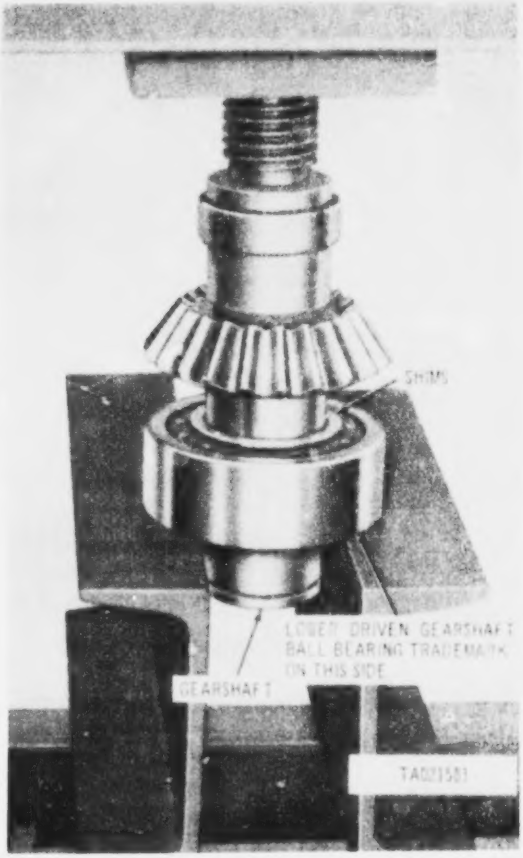

SHIMS
LOWER DRIVEN GEARSHAFT BALL BEARING TRADEMARK ON THIS SIDE
GEARSHAFT
TA021581

Figure 3-225. Pressing fan driven gearshaft into lower gearshaft ball bearing.

(3) Position bearing spacer (fig. 3-226) on fan driven gearshaft and start upper gearshaft ball bearing on gearshaft and press gearshaft into ball bearing. Secure upper gearshaft bearing on fan driven gearshaft with retaining ring (10, fig. 3-216).

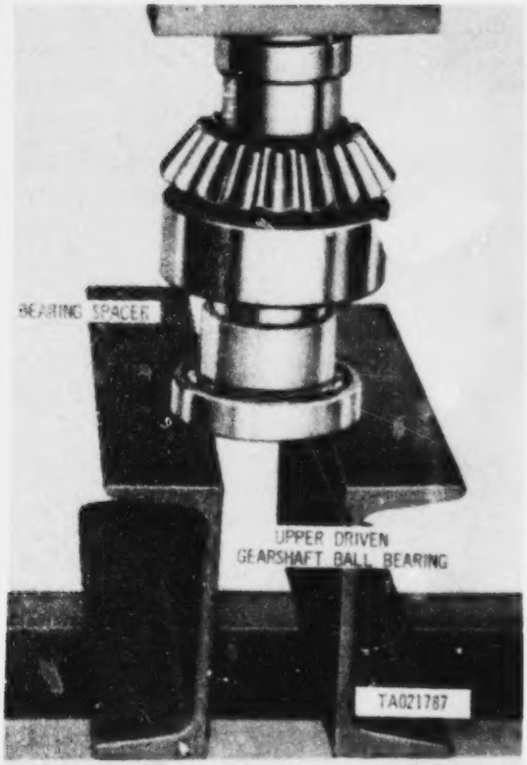


Figure 3-226. Pressing fan driven gearshaft into upper gearshaft ball bearing.

(4) Position assembled fan drive driven bevel gearshaft, shims, ball bearing, spacer, ball bearing and retaining ring in front fan drive housing (2) and secure with bolt (36) new key washer (37) and lock plate (38). Bend tab on washer.

(5) Determine backlash for fan drive bevel gearshaft. Position original shims (20, fig. 3-216) on end of inner bearing race (side opposite bearing trade mark) on front bevel gearshaft ball bearing. Measure total thickness of bearing face and shim, from shim on inner race to face of outer race, with end play removed. Thickness must be from 0.7891 inch minimum to 0.7911 inch maximum. When total thickness is more than 0.7911 inch, strip 0.002 inch thick laminations from the shim pack until the correct thickness is obtained. When total thickness is less than 0.7891 inch, add 0.002 inch thick shims (stripped from a new shim pack part No. 8622455) as necessary. Figure 3-224 illustrates shim location and measuring points.

(6) Position shim (fig. 3-227) of predetermined thickness (fig. 3-224) over bearing hub of front fan drive bevel gearshaft, and press bevel gearshaft front ball bearing on gearshaft (fig. 3-227). Install bevel gearshaft rear ball bearing in the same manner. Secure gearshaft rear ball bearing with retaining ring (34, fig. 3-216).

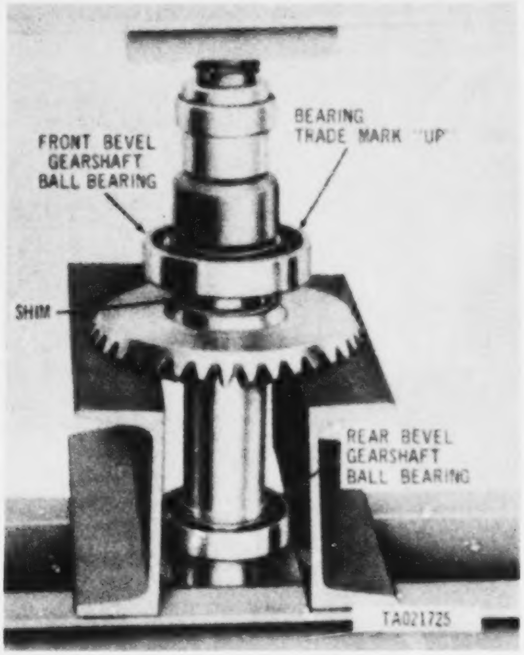

FRONT BEVEL GEARSHAFT BALL BEARING
BEARING TRADE MARK "UP"
SHIM
REAR BEVEL GEARSHAFT BALL BEARING
TA021725

Figure 3-227. Pressing front bevel gearshaft ball bearing on gearshaft.

(7) Install bearing support (16, fig. 3-216) on fan drive bevel gearshaft front ball bearing (19), and install bearing support (35) on rear ball bearing (22). Position assembled fan drive bevel gearshaft, ball bearings, and bearing supports in front drive housing (2) and secure with four slotted nuts (17) and cotter pins (18).

(8) Position fan drive oil seal housing (fig. 3-228) on arbor press, coat flange face of new oil seal with plastic lead sealer, and position oil seal on housing base with lip of seal toward fan drive housing cover mounting face and press oil seal in housing.

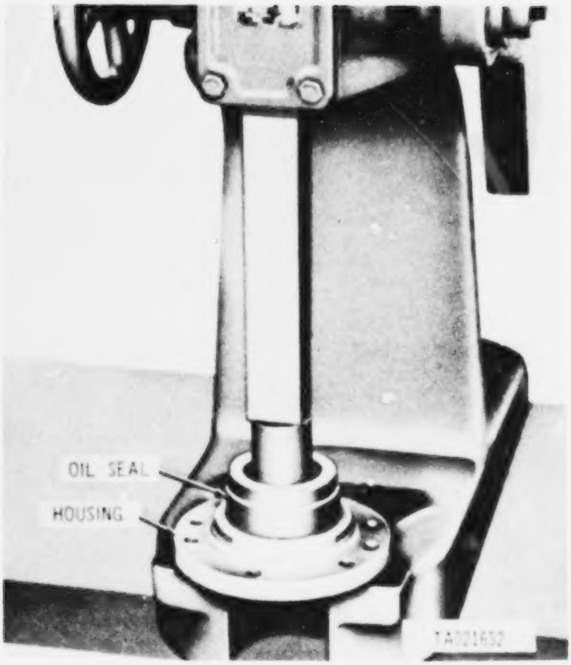


Figure 3-228. Pressing oil seal into fan drive oil seal housing.

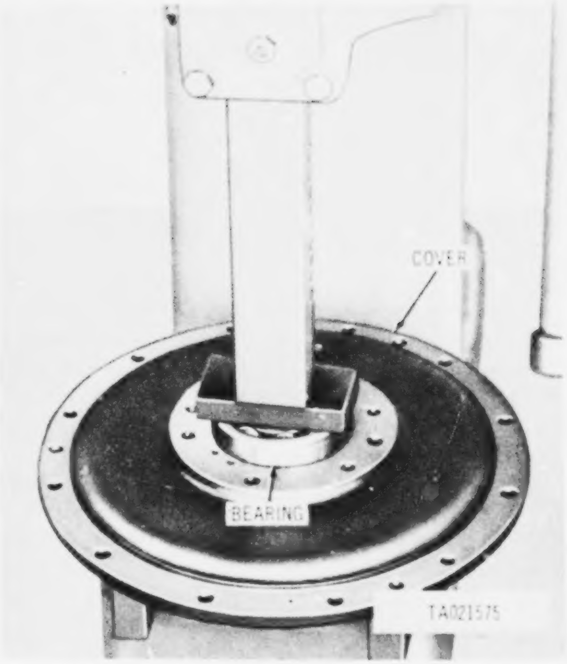


Figure 3-229. Pressing clutch upper ball bearing into fan drive housing.

(9) Position fan drive housing cover (fig. 3-229) on arbor press using suitable blocks for support and press clutch upper ball bearing into cover.

NOTE

Install eight self-locking nuts securing front fan drive covers on the short studs, four nuts are used when installing two fuel injector tube brackets. Install four self-locking nuts on short studs securing rear fan drive cover, eight nuts are used when installing four fuel injector tube brackets.

(10) Install assembled fan drive clutch assembly (6, fig. 3-212) in front fan drive housing assembly (2, fig. 3-216). Using a new preformed packing (7, fig. 3-212) install assembled fan drive housing cover (5) on drive housing cover. Install slotted nuts (8) securing cover to housing. (Only four nuts are required on rear fan tower).

(11) Coat lip of fan drive vertical shaft oil seal (1) with GAA grease MIL-G-10924, and install fan drive oil seal housing (2) on fan drive housing cover (5) and secure with six drilled head bolts (10) and flat washer (9) and install locking wire.

Section XIV. REPAIR OF REAR FAN DRIVE HOUSING AND CLUTCH ASSEMBLY AND ACCESSORY DRIVE HOUSING

3-95. General

This section covers the repair of the rear fan drive housing and clutch assembly, and accessory drive housing. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operation. Repair standards of individual components follow the inspection procedures. Stud identification tables are included where applicable.

3-96. Disassembly

a. Rear Fan and Accessory Drive Housing.

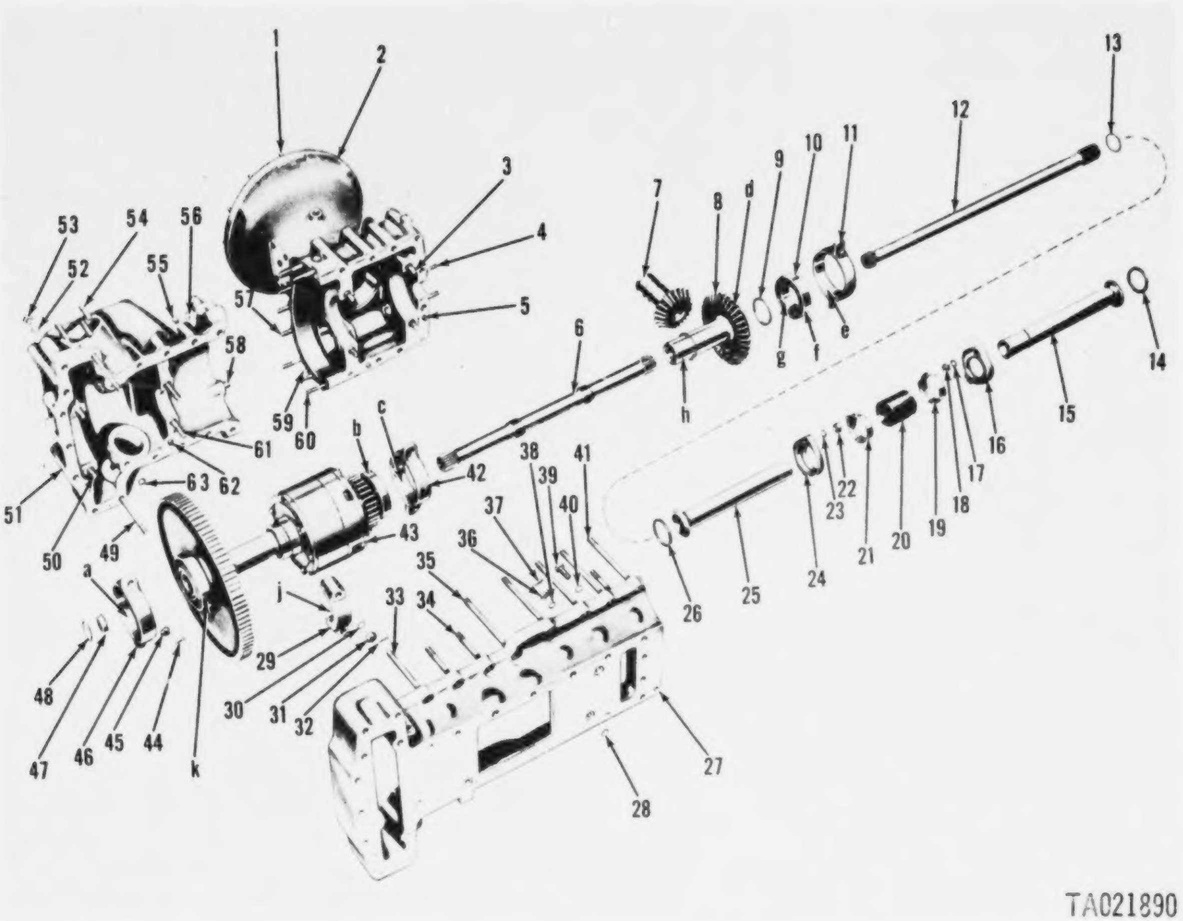
(1) Refer to paragraph 3-91 and remove oil seal housing from fan drive housing cover.

(2) Refer to paragraph 3-91 and remove fan drive clutch and cover from rear fan drive housing assembly.

(3) Remove and discard four preformed packings (63, fig. 3-230) from oil transfer tubes. Remove two cotter pins (32) slotted nuts (31) and flat washers (30) attaching injection advance bearing cap (29) to accessory drive housing (51) and remove bearing cap.

NOTE

Bearing cap and accessory drive housing are stamped with corresponding numbers (fig. 3-255) to prevent mismating of parts. Cap should be loosely attached on housing after advance assembly is removed.



1 Fan drive housing cover stud
2 Rear fan drive housing
3 Fan drive driven bevel gearshaft bearing support stud
4 Inter-fan drive shaft cover adapter stud
5 Dowel pin
6 Flywheel end fan drive shaft
7 Rear fan drive driven bevel gearshaft
8 Fan drive bevel gearshaft
9 Fan drive bevel gearshaft shim
10 Fan drive bevel gearshaft ball bearing
11 Fan drive bevel gearshaft bearing support
12 Intermediate fan drive shaft
13 Inter-fan drive shaft forward retaining ring
14 Inter-fan drive shaft forward cover preformed packing
15 Fan drive shaft forward cover
16 Fan drive shaft forward cover adapter
17 Flat washer
18 Self-locking nut
19 Inter-fan drive shaft cover hose and hose clamp
20 Inter-fan drive shaft cover hose
21 Inter-fan drive shaft cover hose and hose clamp
22 Self-locking nut
23 Flat washer
24 Fan drive shaft rear cover adapter
25 Inter-fan drive shaft rear cover
26 Inter fan drive shaft rear cover preformed packing
27 Fan drive housing and accessory drive housing base
28 Oil transfer tube preformed packing
29 Injection advance bearing cap
30 Flat washer
31 Slotted hex nut
32 Cotter pin
33 Accessory drive housing stud
34 Accessory drive housing stud
35 Accessory drive housing stud
36 Slotted hex nut
37 Cotter pin
38 Flat washer
39 Hex head capscrew
40 Flat washer
41 Rear fan drive housing stud
42 Injection driven gearshaft hub clamp
43 Injection automatic advance assembly
44 Cotter pin
45 Slotted hex nut
46 Accessory driven gearshaft hub clamp
47 Accessory driven gearshaft plug
48 Flywheel end fan drive shaft plug and retaining ring
49 Accessory drive housing base and crankcase stud
50 Accessory cam drive bevel gearshaft support stud
51 Accessory drive housing
52 Flat washer
53 Self-locking nut
54 Accessory cam drive bevel gearshaft support stud
55 Self-locking nut
56 Flat washer
57 Accessory fan drive housing stud
58 Injection pump driven shaftgear pin
59 Dowel pin
60 Accessory drive housing stud
61 Injection advance bearing cap stud
62 Dowel pin
63 Oil transfer tube preformed packing

Figure 3-230. Rear fan and automatic injection advance drive – exploded view.

(4) Remove six cotter pins (44, fig. 3-230) and slotted nuts (45) attaching front bearing support (11), intermediate hub clamp (42) and rear hub clamp (46) to accessory drive housing (51). Remove support, hub clamps, and injection pump automatic advance assembly (43) from rear fan and accessory drive housing as an assembly.

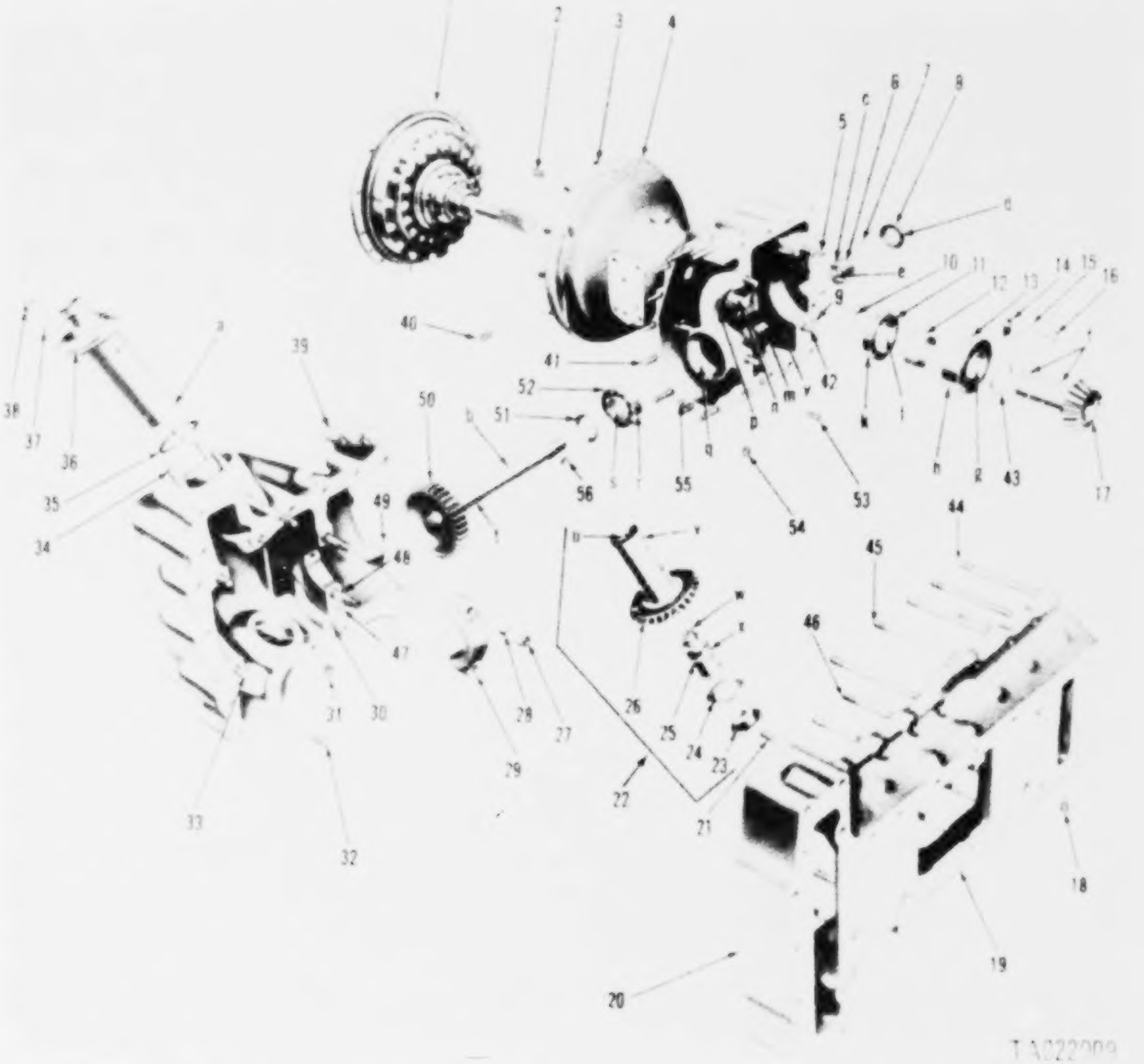
b. Clutch Cover, Bearing and Vertical Drive Shaft Oil Seal. Separate clutch cover and bearing from clutch assembly and remove clutch upper ball bearing and vertical drive shaft oil seal, paragraph 3-91.

c. Rear Fan and Accessory Drive Housing.

(1) Remove six self-locking nuts (38, fig. 3-231) and flat washers (37) attaching left and right camshaft drive inner supports (36) to accessory drive housing (39). Separate camshaft drive inner supports from accessory drive housing and remove right and left camshaft drive gearshaft assemblies (22). Remove and discard preformed packings (35) from inner supports.

(2) Straighten tab on key washer (24) and remove threaded plug (23), key washer, and oil transfer plug (25) from camshaft drive gearshaft (26).

(3) Remove fan driven bevel gearshaft (17, fig. 3-231) and associated parts as outlined in paragraph 3-91.

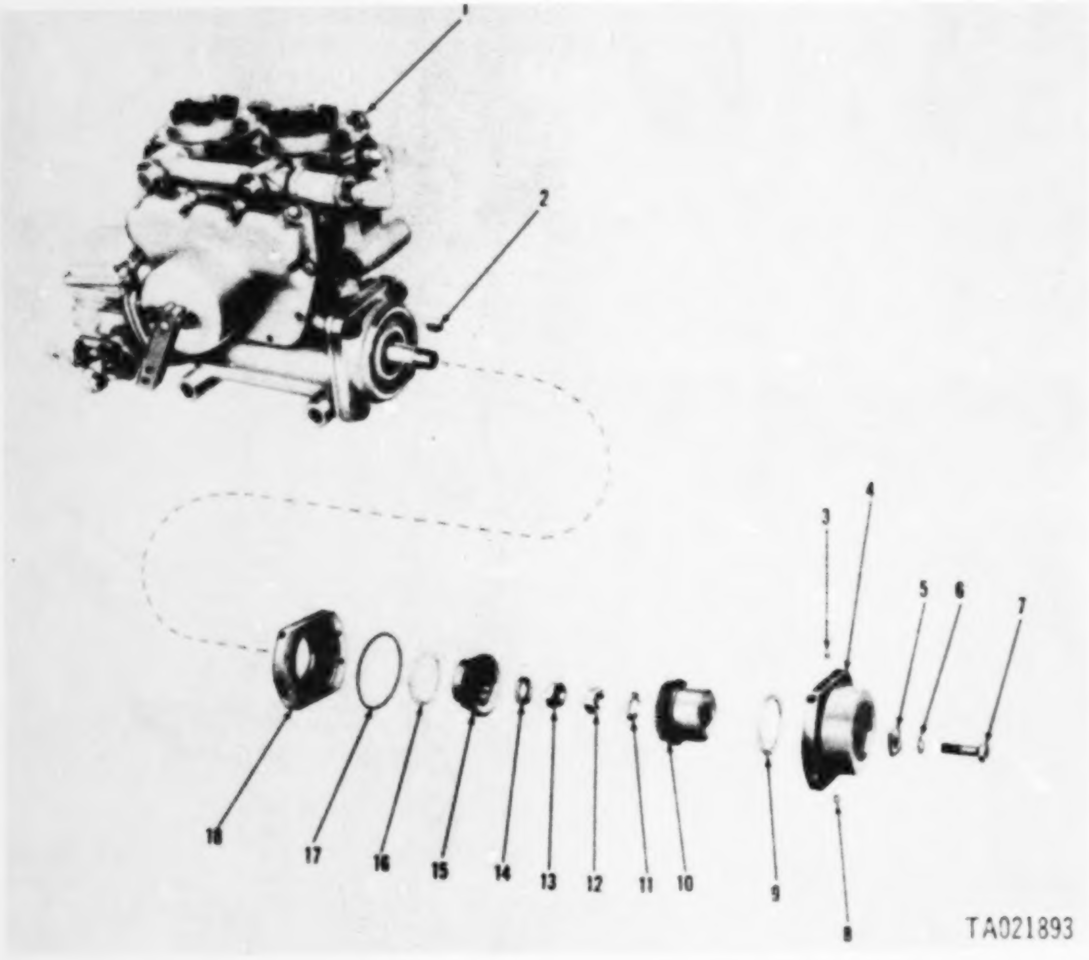


1 Rear fan drive clutch assembly
2 Pipe plug
3 Fan drive housing cover stud
4 Rear fan drive housing
5 Inter-fan drive shaft cover adapter stud
6 Injection pump driven gearshaft needle bearing
7 Needle bearing retaining ring
8 Injection pump driven gearshaft oil seal
9 Dowel pin

Figure 3-231. Rear fan and accessory drive housing, base assemblies and associated parts — exploded view.

LEGEND for fig. 3-231 continued:

10 Fan driven bevel gearshaft retaining ring
11 Fan driven bevel gearshaft ball bearing
12 Fan driven gearshaft spacer
13 Fan driven bevel gearshaft inner ball bearing
14 Bearing retaining plate
15 Key washer
16 Machine bolt
17 Fan drive driven bevel gearshaft
18 Pipe plug
19 Accessory drive housing stud
20 Fan drive housing and accessory drive housing base
21 Accessory drive housing stud
22 Accessory camshaft drive bevel gearshaft assembly
23 Plug
24 Keywasher
25 Oil transfer plug
26 Camshaft drive gearshaft
27 Slotted nut
28 Flat washer
29 Injection advance bearing cap
30 Dowel pin
31 Pipe plug
32 Accessory drive housing base and crankcase stud
33 Accessory driven gear bearing support stud
34 Accessory camshaft drive bevel gearshaft support stud
35 Preformed packing
36 Accessory camshaft drive bevel gearshaft support
37 Flat washer
38 Self-locking nut
39 Accessory drive housing
40 Pipe plug
41 Accessory drive housing stud
42 Fan drive driven bevel gearshaft bearing support studs
43 Fan drive driven bevel gearshaft shims
44 Rear fan drive housing stud
45 Accessory drive housing stud
46 Accessory drive housing stud
47 Dowel pin
48 Injection advance bearing cap studs
49 Injection pump driven shaftgear pin
50 Fuel injection pump gearshaft
51 Recessed washer
52 Fuel injection pump gearshaft bearing
53 Screw thread insert
54 Pipe plug
55 Dowel pin
56 Woodruff key



1 Fuel injection pump
2 Key
3 Pipe plug
4 Fuel injection pump coupling sleeve
5 Spacer
6 Washer
7 Bolt
8 Pipe plug
9 Ring
10 Fuel injection pump coupling hub
11 Lockwasher
12 Plain nut

Figure 3-232. Fuel injection pump coupling assembly — exploded view.

LEGEND for fig. 3-232 continued:

13 Plain nut
14 Lockwasher
15 Fuel injection pump coupling hub
16 Ring
17 Packing
18 Fuel injection pump coupling sleeve

(4) Remove plain nut (12, fig. 3-232) and lockwasher (11) attaching fuel injection pump coupling hub (10), ring (9) and sleeve (4) to fuel injection pump gearshaft (50, fig. 3-231). Remove hub, ring, and sleeve from gearshaft and remove woodruff key (56) from gearshaft.

NOTE

The splined coupler halves are a matched set.

(5) Remove seven self-locking nuts (55, fig. 3-230) and flat washers (56) and separate rear fan drive housing (2) and accessory drive housing (51). Remove three pipe plugs (2, 52 and 40, fig. 3-231) from rear fan drive housing and pipe plug (38) from accessory drive housing.

(6) Remove fuel injection pump gearshaft (50) from rear fan drive housing. Remove fuel injection pump gearshaft oil seal (8) and retaining ring (7) from rear fan drive housing, if inspection (para 3-98) reveals the need for replacement. Remove fuel injection pump driven gearshaft needle bearing (6, fig. 3-231).

(7) Position fuel injection pump gearshaft (fig. 3-233) in arbor press and press gearshaft from ball bearing using press plate to support bearing. Remove bearing recessed washer (51, fig. 3-231) from shaft.

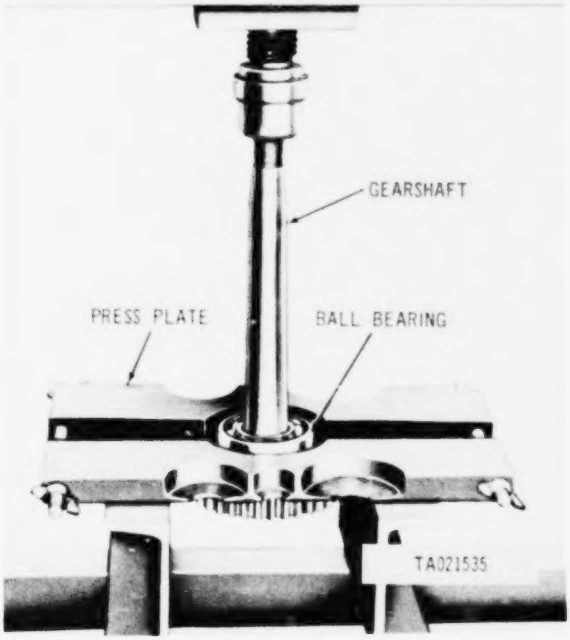


Figure 3-233. Removing fuel injection pump gearshaft ball bearing.

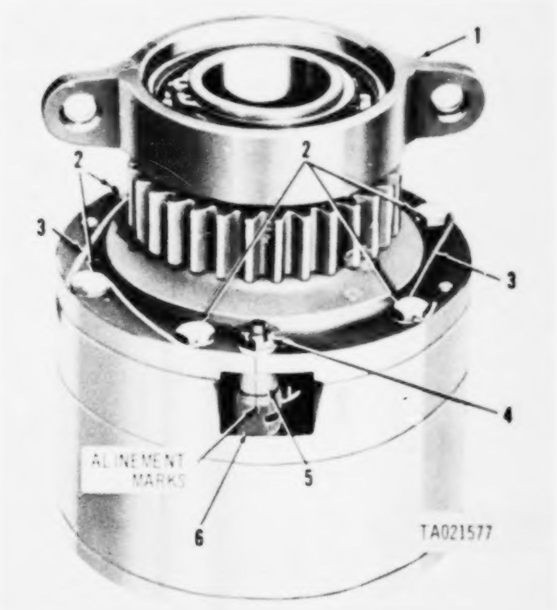
d. Rear Fan Drive Housing Clutch Assembly. Disassemble clutch assembly as outlined in paragraph 3-91.

e. Fuel Injection Pump Advance Assembly.

(1) Remove fan drive bevel gearshaft (8, fig. 3-230), shim (9), ball bearing (10) and support (11) from flywheel end fan drive shaft (6) as an assembly. Remove bearing support from ball bearing. Press fan drive bevel gearshaft from ball bearing and remove and retain shims (9) for use during assembly.

NOTE

Before removing bolts securing the components of the advance assembly, check alinement and legibility of scribe marks on adjusting ring boss, flyweight, and drive gearshaft flange (fig. 3-234). The marks must be alined to insure proper assembly. If the scribe marks are not alined, scribe a new line on the gearshaft flange in alinement with the ring boss scribe line. Identify the new line using a prick punch dot or some other method. The new gear flange mark and ring boss must be in alinement for proper assembly.



1 Injection driven gearshaft hub clamp
2 Bolt
3 Locking wire
4 Slotted nut
5 Adjusting ring
6 Flyweight

Figure 3-234. Removing advance flyweight adjusting ring and injection pump drive gearshaft.

(2) Remove injection driven gearshaft hub clamp (1, fig. 3-234) from injection pump drive gearshaft ball bearing. Cut locking wire (3) and remove six bolts (2) attaching drive gearshaft to injection advance vane housing. Remove two cotter pins, slotted nuts (4), and flat washers attaching injection advance flyweight fulcrum pin to injection pump drive gearshaft. Remove gearshaft (17, fig. 3-236), ball bearing (15) and retaining ring (14) as an assembly.

(3) Removing retaining ring (14) securing injection pump drive gearshaft ball bearing (15) to drive gearshaft (17). Position injection pump drive gearshaft (fig. 3-235) in arbor press and press drive gearshaft from ball bearing using press plate to support bearing.

(4) Remove advance flyweight adjusting ring (18, fig. 3-236) flyweights (10) and oil control housing (9) from flyweight housing (8) as an assembly. Disconnect and remove flyweight compression spring (20) seats (22) and retainers (21), from flyweight and remove flyweights from adjusting ring. Separate adjusting ring and remove from oil control housing.

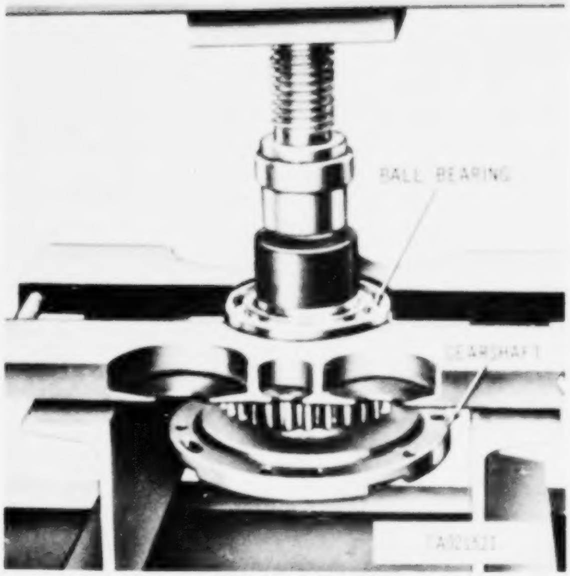
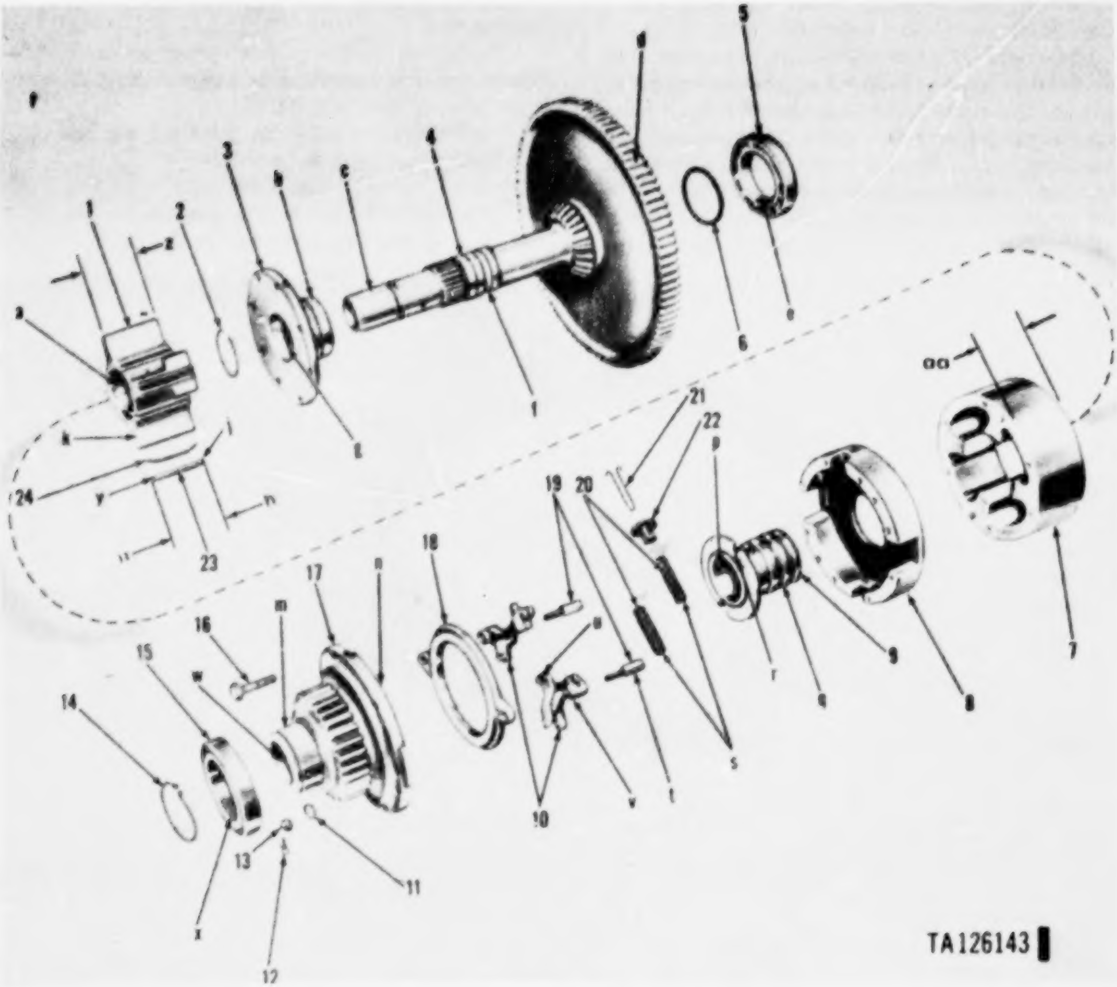


Figure 3-235. Removing injection pump drive gearshaft ball bearing.



1 Injection advance vane
2 Advance unit cover retaining ring
3 Injection advance vane housing cover
4 Accessory driven gearshaft
5 Accessory driven gearshaft ball bearing
6 Accessory driven gearshaft ball bearing shim
7 Injection advance vane housing
8 Injection advance flyweight housing
9 Advance oil control housing
10 Injection advance flyweight assembly
11 Injection advance flyweight fulcrum pin washer
12 Injection advance flyweight fulcrum pin cotter pin
13 Injection advance flyweight fulcrum pin nut
14 Injection pump drive gearshaft ball bearing retaining ring
15 Injection pump drive gearshaft ball bearing
16 Injection advance vane housing bolt
17 Injector pump drive gearshaft
18 Injection advance flyweight adjusting ring
19 Injection advance flyweight fulcrum pin
20 Fuel injection advance flyweight compression spring
21 Fuel injection advance flyweight compression spring retainer
22 Fuel injection advance flyweight compression spring seat
23 Injection advance vane seal
24 Injection advance vane seat spring

Figure 3-236. Automatic injection advance assembly — exploded view.

(5) Remove flyweight housing (8) from advance housing (7) noting the location of dowel pins in advance vane housing for alinement with holes in flyweight housing during assembly.

(6) Remove advance vane housing (7) from advance vane housing cover (3) noting location of dowel pins in advance housing cover for alinement with holes in advance vane housing during assembly.

(7) Partially separate advance vane (1) and vane housing (7) and remove eight seals (23) and springs (24) and remove vane from housing.

f. Advance Vane Housing Cover and Accessory Drive Gearshaft.

(1) Using a suitable gear puller remove accessory driven gear hub clamp (46, fig. 3-230) from accessory driven gearshaft ball bearing (5, fig. 3-236). Remove

ball bearing and shim (6) from accessory driven gearshaft (4).

(2) Cut four pins 7/16-inch (approx.) long from 7/32-inch diameter brass brazing rod or other soft material. Insert the pins in the four equally spaced holes in bearing portion of advance vane cover. An improvised ring compressing tool of the type shown in figure 2-1 can be fabricated to facilitate removal of the advance vane cover internal retaining ring. If the improvised tool is used, install it over the pins and tighten bolts sufficiently to compress the advance vane cover internal retaining ring.

(3) Install accessory drive gearshaft in a soft-jawed vise and using a gear puller remove advance vane housing cover (fig. 3-237).

(4) Remove retaining ring (48, fig. 3-230) and plug (47) from accessory drive gearshaft.

CAUTION

Use extreme care in this operation to prevent damage to vane cover or gearshaft.

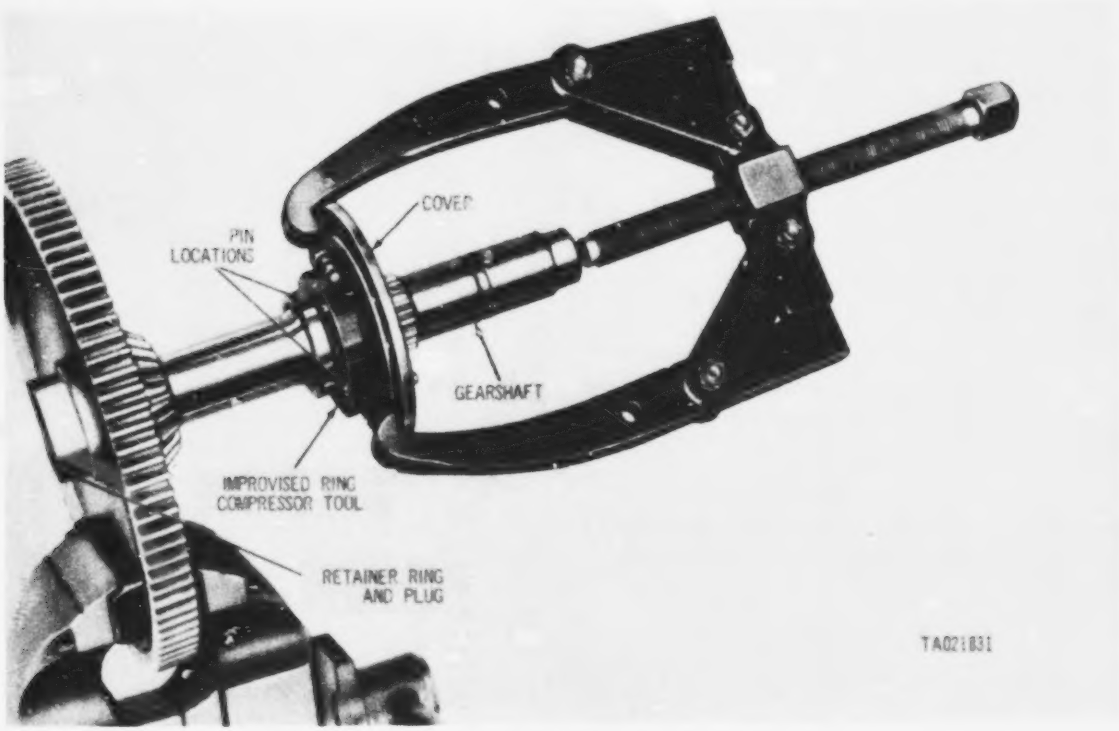


Figure 3-237. Removing advance vane housing cover.

3-97. Cleaning

Refer to paragraph 3-36.

3-98. Inspection and Repair

a. *General.* Refer to paragraphs 3-37 and 3-38.

b. *Fan Drive Gearshaft and Fan Drive Bevel Gearshaft.* Inspect fan driven gearshaft (8, fig. 3-230) and fan drive bevel gearshaft (7) to limits specified in repair standards (table 3-23).

NOTE

If either the fan driven gearshaft or fan drive bevel gearshaft require replacement, both must be replaced as they are a matched gear set and cannot be replaced individually.

c. *Oil Seal.* Refer to paragraph 3-37.

d. *Clutch Assembly.* Refer to paragraph 3-93 and tables 3-20 and 3-21.

e. *Housing Assemblies.* Inspect fan drive clutch disc housing (2, fig. 3-220) rear cooling fan drive housing (4, fig. 3-231) accessory drive housing (39) and rear cooling fan and accessory drive housing base (20) for loose dowel pins and oil transfer tubes if applicable.

f. *Advance Unit Seals and Springs.* Inspect seals (23, fig. 3-236) and springs (24) for cracks, indentations, and wear. Check seals to the limits specified in repair standards (table 3-23).

g. *Flyweight Springs.* Inspect flyweight springs (20, fig. 3-236) seats (22) and retainers (21) for cracks and damage. Check spring tension to limits specified in repair standards (table 3-24).

h. *Studs.* Refer to paragraph 3-38, table 3-22, and figure 3-238 when replacing studs.

Table 3-23. Rear Fan and Accessory Drive Housing Assembly Repair Standards

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts		Wear limits
Rear fan and accessory drive housing.	3-230	a	Inside diameter of bearing support clamp.	3.5432	3.5440	3.5444
	3-230	k	Outside diameter of bearing.	3.5427	3.5433	*
	3-230	k-a	Fit of bearing in support clamp.	0.0013L	0.0001T	0.0017L
	3-236	d	Outside diameter of bearing surface on gearshaft assembly.	2.1655	2.1660	2.1653
	3-236	e	Inside diameter of bearing.	2.1648	2.1654	*
	3-230	e	Inside diameter of bearing support clamp.	3.1495	3.1501	3.1504
	3-230	e-f	Fit of bearing in support.	0.0010L	0.0001T	0.0013L
	3-230	h	Outside diameter of gearshaft.	1.6244	1.6248	1.6240
	3-236	w	Inside diameter of drive gearshaft.	1.6260	1.6270	1.6275
	3-230	w-h	Fit of gearshaft in drive gearshaft.	0.0012L	0.0026L	0.0035L
Fuel injection pump spur shaftgear	3-231	t	Outside diameter of bearing surface on fuel injection pump driven gearshaft.	1.1814	1.1817	1.1813
	3-231	s	Inside diameter of bearing.	1.1807	1.1811	*
	3-231	s-t	Fit of bearing on gearshaft.	0.0003T	0.0010T	0.0002T
	3-236	e-d	Fit of bearing on gearshaft assembly.	0.0001T	0.0012T	0.0001L
	3-230	b	Outside diameter of bearing.	3.1491	3.1496	*
	3-230	c	Inside diameter of bearing support clamp.	3.1495	3.1501	3.1504
	3-230	c-b	Fit of bearing in support.	0.0010L	0.0001T	0.0013L
	3-230	d	Outside diameter of bearing surface on gearshaft.	1.5749	1.5753	1.5747
	3-230	g	Inside diameter of bearing.	1.5743	1.5748	*
	3-230	g-d	Fit of bearing on gearshaft.	0.0001T	0.0010T	0.0001L
	3-230	f	Outside diameter of bearing.	3.1491	3.1496	*
	3-231	r	Outside diameter of bearing.	2.4404	2.4409	*
	3-231	q	Inside diameter of liner in housing.	2.4409	2.4416	2.4419
	3-231	r-q	Fit of bearing in housing.	0.0000	0.0012L	0.0015L
	3-231	m	Inside diameter of liner in housing.	1.4995	1.5002	1.5006
	3-231	c	Outside diameter of needle bearing.	1.4995	1.5000	*
	3-231	c-m	Fit of needle bearing in housing.	0.0007L	0.0005T	0.0010L
	3-231	b	Outside diameter of needle bearing surface on gearshaft.	0.9995	1.0000	0.9993
	3-231	e	Inside diameter of needle bearing.	0.9995	1.0000	*
	3-231	e-b	Fit of gearshaft in needle bearing.	0.0005L	0.0005T	0.0007L
	3-231	y	Inside diameter of oil seal bore in housing.	1.7500	1.7510	1.7520
	3-231	d	Outside diameter of oil seal.	1.7540	1.7580	*
	3-231	d-y	Fit of oil seal in housing.	0.0030T	0.0080T	0.0020T
	3-231	p	Inside diameter of bearing bore (small) in housing.	2.6772	2.6779	2.6782
	3-231	k	Outside diameter of bearing.	2.6767	2.6772	*
	3-231	k-p	Fit of bearing in housing.	0.0000	0.0012L	0.0015L
	3-231	n	Inside diameter of bearing bore (large) in housing.	3.1496	3.1503	3.1506
	3-231	h	Outside diameter of bearing.	3.1491	3.1496	*
	3-231	h-n	Fit of bearing in housing.	0.0000	0.0012L	0.0015L

See foot note at end of table.

Table 3-23. Rear Fan and Accessory Drive Housing Assembly Repair Standards — Continued

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts		Wear limits
Rear fan and fuel injection drive.	3-231	f	Outside diameter of bearing surface on gearshaft.	1.5749	1.5753	1.5747
	3-231	j	Inside diameter of bearing.	1.5743	1.5748	*
	3-231	j-f	Fit of bearing on gearshaft.	0.0001T	0.0010T	0.0001L
	3-231	g	Inside diameter of bearing.	1.5743	1.5748	*
	3-231	g-f	Fit of bearing on gearshaft.	0.0001T	0.0010T	0.0001L
	3-230	j	Inside diameter of injection advance bearing.	2.3770	2.3780	*
	3-236	b	Outside diameter of hub on advance unit cover.	2.3735	2.3745	2.3730
	3-236 3-230	b-j	Fit of cover in bearing.	0.0025L	0.0045L	0.0050L
Lower camshaft drive quill bevel gearshaft.	3-231	u	Inside diameter of hub in gearshaft.	1.1260	1.1270	*
	3-231	x	Outside diameter of lower oil transfer plug.	1.1250	1.1255	*
	3-231	x-u	Fit of plug in hub	0.0005L	0.0020L	*
	3-231	v	Outside diameter of hub on gearshaft.	1.4970	1.4980	1.4960
	3-231	a	Inside diameter of bore in inner support housing.	1.5000	1.5010	1.5020
	3-231	v-a	Fit of hub in housing bore.	0.0020L	0.0040L	0.0060L
	3-258	r	Inside diameter of camshaft drive quill (both ends).	0.6292	0.6300	0.6315
	3-231	w	Spherical outside diameter of lower oil transfer plug.	0.6275	0.6280	0.6265
	3-258	r-w	Fit of lower transfer plug in quill.	0.0012L	0.0025L	0.0050L

Refer to paragraph 3-37c for explanation of symbols.

Table 3-24. Fuel Injection Pump Advance Unit Assembly Repair Standards

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts		Wear limits
Fuel injection pump advance unit assembly	3-236	g	Inside diameter of cover.	1.8125	1.8130	1.8135
	3-236	f	Outside diameter of mating surface on gearshaft.	1.8115	1.8120	1.8110
	3-236	f-g	Fit of cover on gearshaft.	0.0005L	0.0015L	0.0025L
	3-236	d	Outside diameter of bearing surface on gearshaft assembly.	2.1655	2.1660	2.1653
	3-236	e	Inside diameter of bearing.	2.1648	2.1654	*
	3-236	d-e	Fit of bearing on gearshaft assembly.	0.0001T	0.0012T	0.0001L
	3-230	k	Outside diameter of bearing.	3.5427	3.5433	*
	3-230	a	Inside diameter of bearing support.	3.5432	3.5440	3.5442
	3-230	a-k	Fit of bearing in support.	0.0013L	0.0001T	0.0015L
	3-236	b	Outside diameter of hub on cover.	2.3735	2.3745	2.3730
	3-230	j	Inside diameter of injection advance bearing.	2.3770	2.3780	2.3790
	3-230 3-236	j-b	Fit of hub on cover in advance bearing.	0.0025L	0.0045L	0.0060L
	3-236	a	Inside diameter of vane.	1.8730	1.8735	1.8740
	3-236	q	Outside diameter of oil control advance valve.	1.8710	1.8715	1.8708
	3-236	q-a	Fit of vane on housing.	0.0015L	0.0025L	0.0032L
	3-236	z	Width of injection advance vane.	Controlled to provide 0.0010 to 0.0015 clearance with dimension aa below at assembly.		*
	3-236	c	Outside diameter of gearshaft.	1.4996	1.5000	1.4994
		p	Inside diameter of oil control advance housing.	1.5015	1.5020	1.5030

See foot note at end of table.

Table 3-24. Fuel Injection Pump Advance Unit Assembly Repair Standards — Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Fuel injection pump advance unit assembly.	3-236	p-c	Fit of oil control advance housing on gearshaft assembly.	0.0015L	0.0024L	0.0036L
	3-236	j	Width of seal	0.0990	0.1010	0.0980
	3-236	k	Width of slot in vane.	0.1020	0.1060	0.1070
	3-236	k-j	Fit of seal in vane	0.0010L	0.0070L	0.0090L
	3-236	h	Length of seal	2.1190	2.1210	*
	3-236	y	Thickness of seal	0.1300	0.1350	*
	3-236	n	Inside diameter of drive gearshaft gear.	1.5015	1.5020	1.5030
	3-236	n-c	Fit of drive gearshaft on gearshaft assembly.	0.0015L	0.0024L	0.0036L
	3-236	u	Outside diameter of pin on flyweight.	0.2500	0.2510	0.2490
	3-236	r	Width of slot in control valve.	0.2510	0.2550	0.2560
	3-236	r-u	Fit of pin in slot	0.0000	0.0050L	0.0070L
	3-236	t	Outside diameter of flyweight pin.	0.3110	0.3115	*
	3-236	v	Inside diameter of flyweight pin hole in flyweight.	0.3120	0.3130	*
	3-236	v-t	Fit of flyweight pin in flyweight.	0.0005L	0.0020L	*
	3-236	m	Outside diameter of bearing surface on spur gearshaft.	1.9686	1.9690	1.9684
	3-236	x	Inside diameter of bearing.	1.9680	1.9685	*
	3-236	x-m	Fit of bearing on spur gearshaft.	0.0001T	0.0010T	0.0001L
	3-236	s	Spring, helical: compression			
			Approximate free length.	1.6300 inches		
			Scale reading at 1.0300 inch.	12.3 lbs to 14.9 lbs		
			Maximum solid height.	0.6510 inch		
	3-236	w	Inside diameter of gearshaft	1.6260	1.6270	1.6275
	3-230	h	Outside diameter of drive gearshaft.	1.6244	1.6248	1.6240
	3-230 3-236	h-w	Fit of gearshaft in drive gearshaft.	0.0012L	0.0026L	0.0035L
	3-236	aa	Width of injection advance vane housing.	2.1233	2.1247	*

Refer to paragraph 3-37c for explanation of symbols.

Table 3-25. Rear Fan and Accessory Drive Housings Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd.	Stud size and length
3-238	1	5/8	1	5/16-18 (19/32) x 5/16-24 (17/32) x 1-1/8
3-238	2	1-11/16	4	5/16-18 (3/4) x 5/16-24 (23/32) x 2-5/16
3-238	3	25/32	4	5/16-18 (3/4) x 5/16-24 (19/32) x 1-7/16
3-238	4	29/32	8	5/16-18 (3/4) x 5/16-24 (19/32) x 1-3/4
3-238	5	1-1/8	6	3/8-16 (15/16) x 3/8-24 (13/16) x 1-5/16
3-238	6	49/64	6	3/8-16 (27/32) x 3/8-24 (7/8) x 1-3/4
3-238	7	3-29/32	2	3/8-16 (15/16) x 3/24 (13/16) x 4-11/16
3-238	8	1-25/32	2	3/8-16 (13/16) x 3/8-24 (27/32) x 2/15-16
3-238	9	1	5	5/16-18 (3/4) x 5/16-24 (23/32) x 1-5/8
3-238	10	3-1/2	2	3/8-16 (27/32) x 3/8-24 (11/16) x 4-5/16
3-238	11	4-5/8	1	3/8-16 (51/64) x 3/8-24 (11/16) x 5-1/4
3-238	12	2-9/16	4	3/8-16 (25/32) x 3/8-24 (7/8) x 3-5/16
3-238	13	4-1/4	9	3/8-16 (51/64) x 3/8-24 (11/16) x 5
3-238	14	5-1/4	2	3/8-16 (51/64) x 3/8-24 (11/16) x 6
3-238	15	1	2	5/16 (3/4) x 5/16-24 (19/32) x 1-1/2
3-238	16	29/32	8	5/16-18 (3/4) x 5/16-24 (13/16) x 1-9/16
3-238	17	25/32	4	5/16-18 (5/8) x 5/16-24 (3/4) x 1-7/16

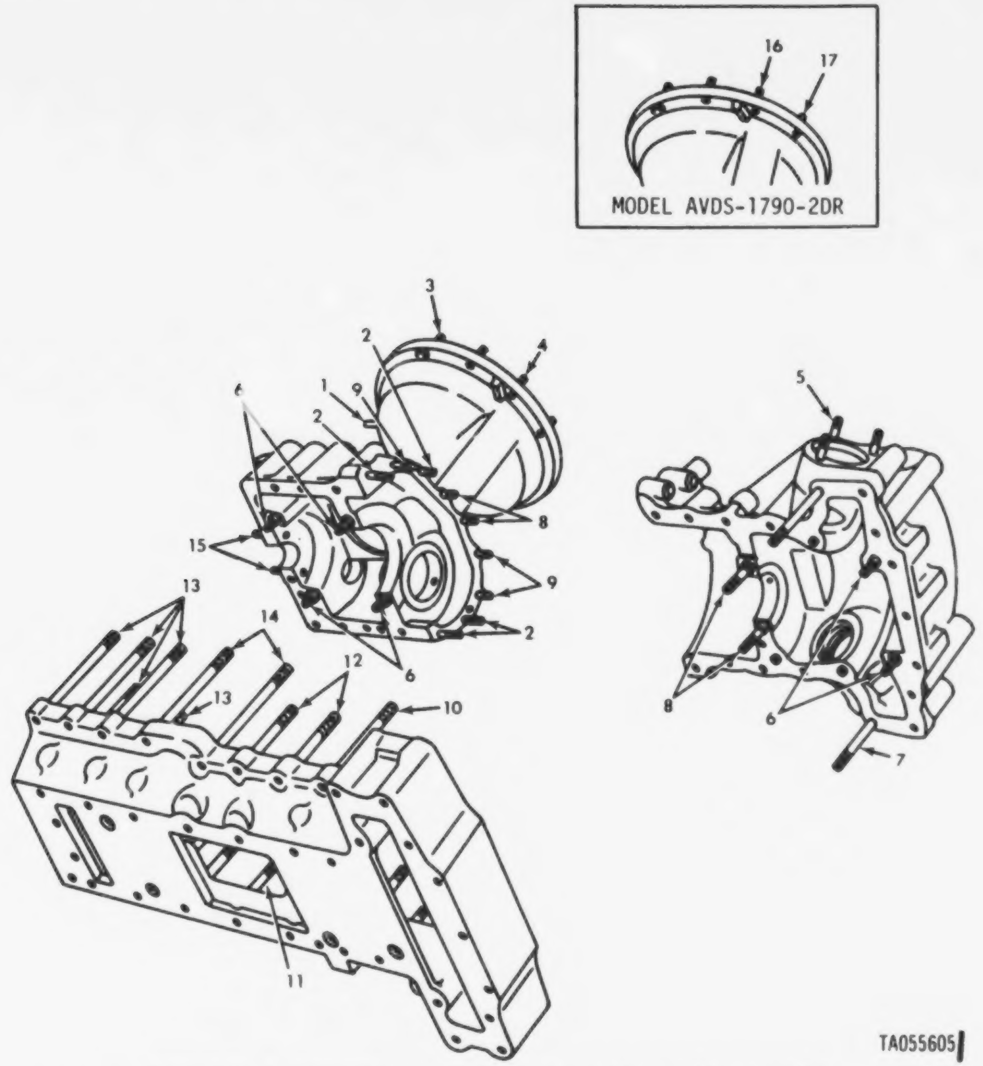


Figure 3-238. Rear fan and accessory drive housing and base studding assembly.

i. Fuel Injection Pump Drive Coupler Half. Inspect the front and rear coupler sleeves (4 and 18, fig. 3-232) and hubs for wear and mutilation and for fit with mating hub splines (10 and 15) the splines of mating parts. Mating splines must match without binding, with a maximum total backlash of 0.006 inch from the input end through the output end. Check the quad rings (9 and 16) for cracks, tears, deterioration, or loss of resilience.

3-99. Assembly

a. Fuel Injection Pump Advance Unit Assembly.

(1) Install accessory driven gearshaft plug (47, fig. 3-230) and secure with retaining ring (48).

(2) Measure the total thickness (A, fig. 3-239) of ball bearing inner race to face of outer race, with end play removed. Measure the total thickness (B) from inner face of bevel gear to inner face of bearing journal. Add thickness of ball bearing race (A) and gearshaft measurement (B) and subtract from 2.6605 to 2.6625-inch. Add or remove 0.002-inch shim laminations from shim pack, Part No. 8761041, until required dimension (C) is obtained.

NOTE

The shim pack has several 0.002-inch laminations. Shims may be stripped from the pack to obtain shim dimensions. If shims must be added, they will have to be stripped from a new shim pack.

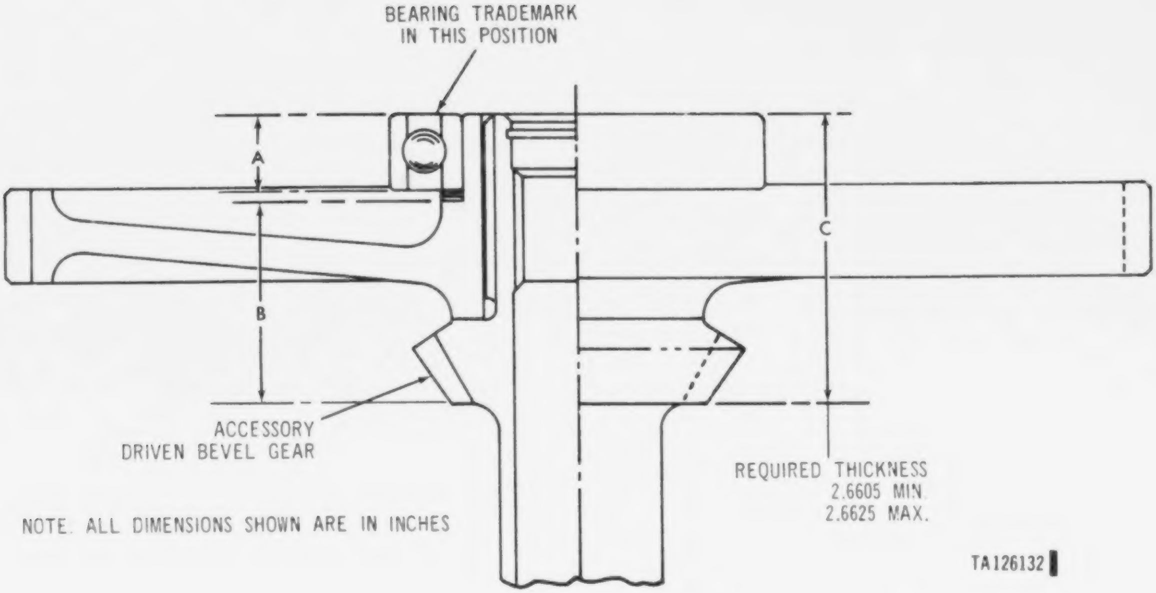

BEARING TRADEMARK
IN THIS POSITION
A
B
C
ACCESSORY
DRIVEN BEVEL GEAR
REQUIRED THICKNESS
2.6605 MIN.
2.6625 MAX.
NOTE. ALL DIMENSIONS SHOWN ARE IN INCHES
TA126132

Figure 3-239. Determining shim thickness for accessory drive bevel gearshaft bearing.

(3) Position shim (fig. 3-240) of predetermined thickness (fig. 3-239) on bearing hub of accessory drive gearshaft. Position accessory driven gearshaft ball bearing on hub, with bearing trade mark facing away from gearshaft (fig. 3-239) and press bearing on gearshaft.

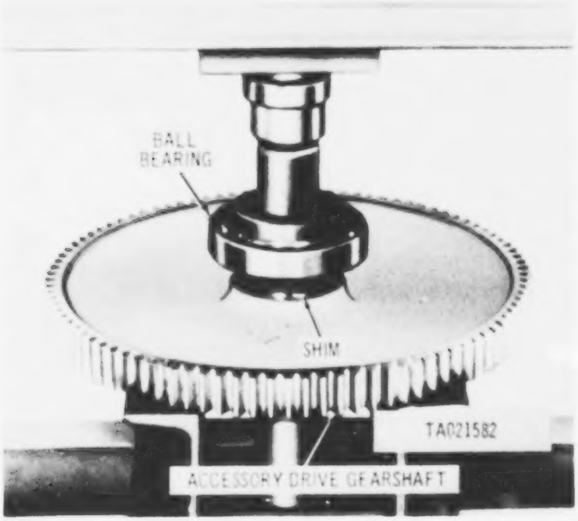
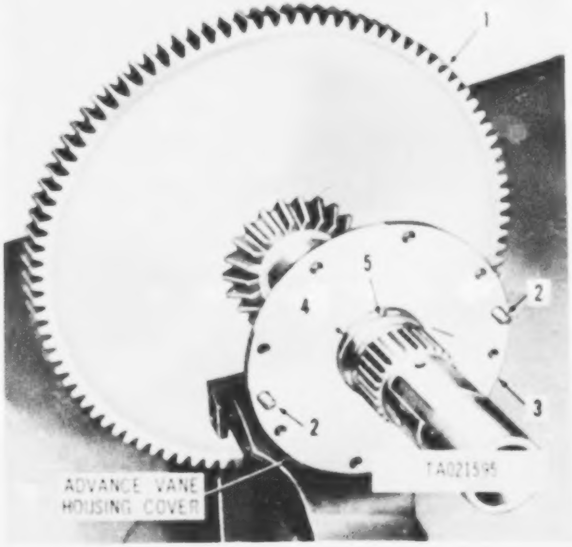

BALL
BEARING
SHIM
TA021582
ACCESSORY DRIVE GEARSHAFT

Figure 3-240. Pressing accessory driven gearshaft ball bearing on gearshaft.

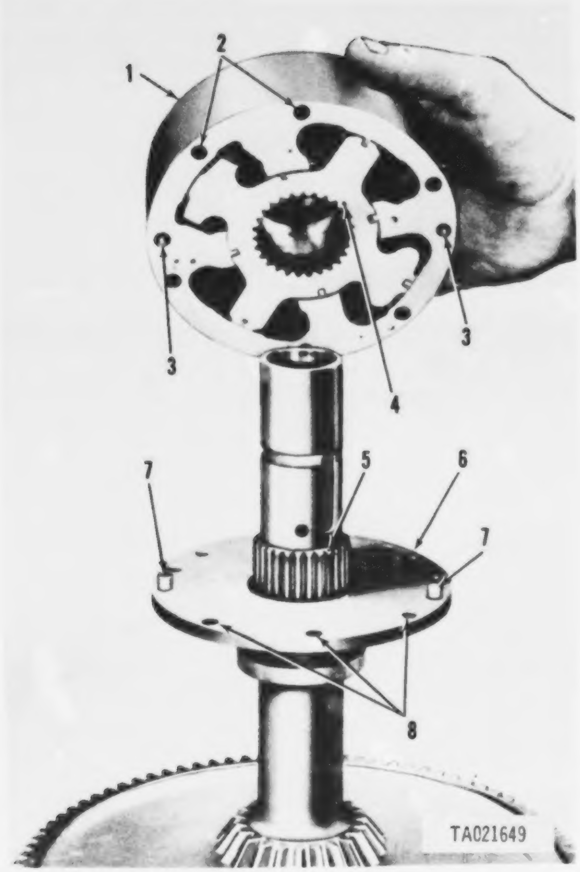
(4) Using a soft faced hammer install accessory driven gearshaft hub clamp (46, fig. 3-230).

(5) Place accessory driven bevel gearshaft (1, fig. 3-241) in a soft jawed vise and install vane housing cover (3) on gearshaft until it exposes the retaining ring groove. Install retaining ring (4) in groove and pull cover (3) forward until retaining ring is seated in the cover retaining ring groove.


1
5
4
2
2
3
ADVANCE VANE
HOUSING COVER
TA021595

1 Accessory drive bevel gearshaft
2 Dowel pin
3 Advance vane housing cover
4 Retaining ring
5 Retaining ring groove

Figure 3-241. Installing advance vane housing cover on accessory bevel gearshaft.



1 Advance vane housing
2 Bolt holes
3 Dowel pin hole
4 Vane spline
5 Gearshaft spline
6 Advance vane housing cover
7 Dowel pin
8 Cover bolt hole

Figure 3-242. Installing advance vane housing and vane.

b. Fuel Injection Pump Advance Assembly.

(1) Install advance vane (1, fig. 3-236) in vane housing (7) approximately half way, and install eight seals (23) and springs (24). Slide vane and seals into vane housing.

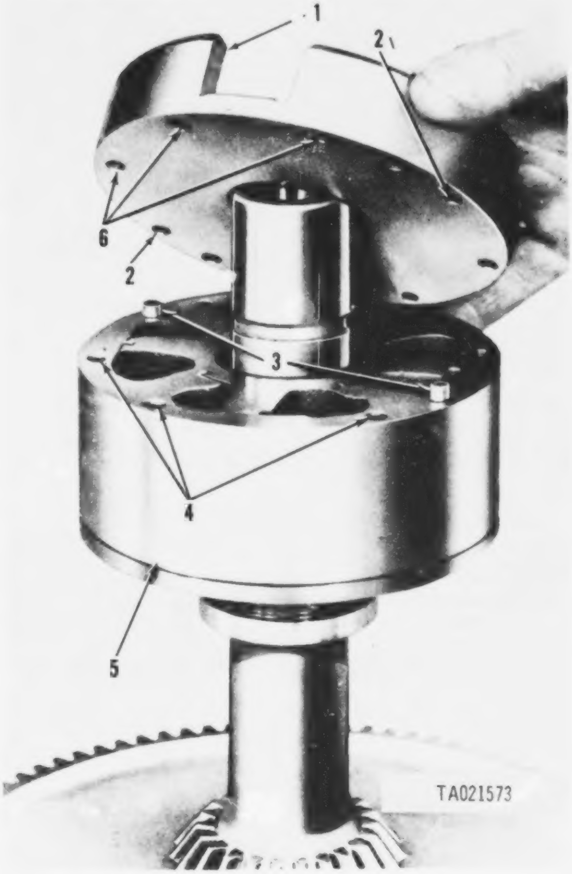
(2) Install advance vane housing (1, fig. 3-242) with vane, seals and springs, on advance vane housing cover with alinement dots on gearshaft spline (4) mating with alinement dot on gearshaft (5).

(3) The vane must have end clearance of 0.001 inch. If vane splines have a snug fit on the accessory drive gearshaft splines insert a 0.001 inch feeler gage between vane and vane housing cover. Gently tap vane until proper end play is obtained, then remove feeler gage. Mate dowel pin holes (3) in vane housing with dowel pins (7) in cover and housing bolt holes (2) with cover bolt holes (8). Tap housing lightly with a soft hammer to seat dowel pins.

NOTE

Dowel pins and dowel pin holes will aline in two positions. However, the bolt holes in cover and housing will aline in one position only. Make certain that cover and housing are correctly positioned so that bolt holes are alined.

(4) Mate dowel holes (2, fig. 3-243) with dowel pins (3) and bolt holes (6) with bolt holes (4) and install flyweight housing (1) on advance vane housing (5). Tap flyweight housing lightly with a soft hammer to seat dowel pins.



1 Flyweight housing
2 Dowel pin hole
3 Dowel pin
4 Bolt hole
5 Advance vane housing
6 Bolt hole

Figure 3-243. Installing flyweight housing.

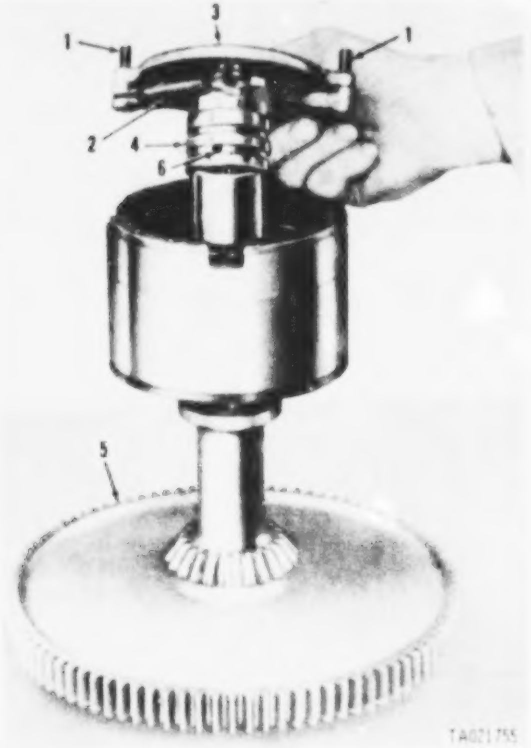
(5) Install two flyweights on adjusting ring with flyweight pins (1, fig. 3-244) installed.

NOTE

Springs are attached to flyweights with roll pins driven thru the loops in the springs.

(6) Install flyweight compression springs, seats and retainers (2) on flyweights and spread flyweights

against springs and install oil control housing in adjusting ring so slots in control housing (4) are alined with flyweight pins. Install the assembled adjusting ring, oil control housing, and flyweights on accessory driven bevel gearshaft (5). Oil hole (6) in lower groove of oil control housing must aline with slot in gearshaft.



1 Flyweight pin
2 Spring
3 Adjusting ring
4 Oil control housing
5 Accessory driven gearshaft
6 Oil hole

Figure 3-244. Installing advance flyweight adjusting ring and flyweight.

(7) Position drive gearshaft ball bearing (fig. 3-245) on drive gearshaft and carefully press ball bearing on gearshaft. Install retaining ring (14, fig. 3-236) securing gearshaft ball bearing.

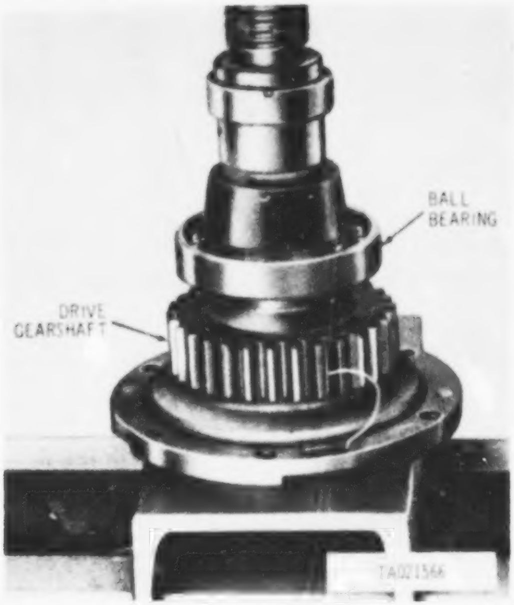
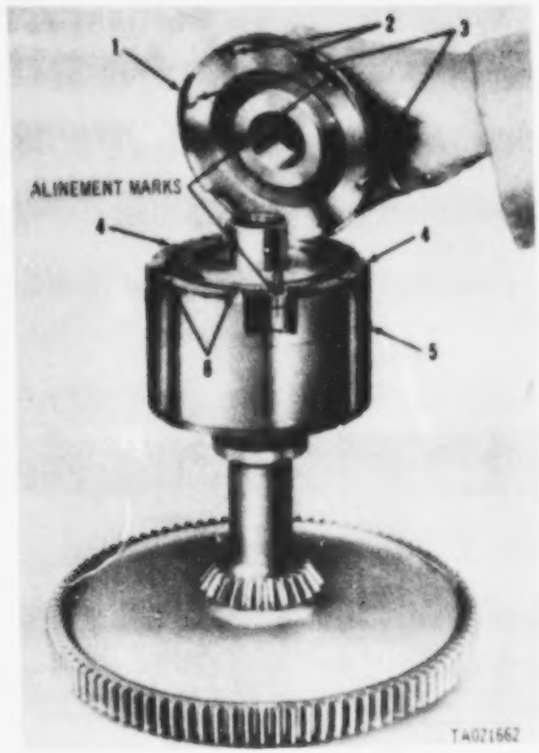


Figure 3-245. Pressing drive gearshaft ball bearing on drive gearshaft.

(8) Mate dowel pins (3, fig. 3-246) and bolt holes (2) in gearshaft with dowel pin holes (4) and bolt holes (6) in housing and install the assembled injection pump drive gearshaft on flyweight housing.

NOTE

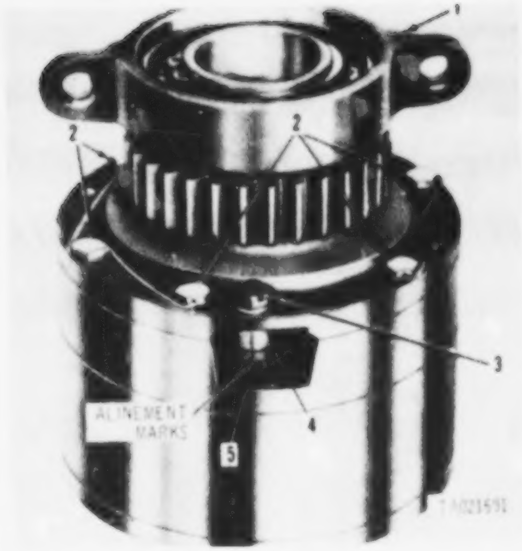
The scribe line on gearshaft flange and adjusting ring boss must be alined.



1 Injection pump drive gearshaft
2 Bolt hole
3 Dowel pin
4 Dowel pin hole
5 Flyweight housing
6 Bolt hole
7 Alinement mark

Figure 3-246. Installing injection pump drive gearshaft.

(9) Install six bolts (2, fig. 3-247) through gearshaft flange, flyweight housing advance vane housing and secure in vane housing cover. Secure bolts with locking wire. Move the adjusting ring to aline scribe marks (6) on ring, flyweight (5) and drive gearshaft flange (7). Install two slotted nuts, flat washers (3) and cotter pins on flyweight pins securing adjusting ring (4). Install injection driven gearshaft hub clamp (1).



1 Injection driven gearshaft hub clamp
2 Bolt
3 Nut and washer
4 Adjusting ring
5 Flyweight
6 Alinement marks
7 Drive gearshaft flange

Figure 3-247. Installing advance flyweight adjusting ring and bearing support clamp.

c. Test.

(1) Test fuel injection pump advance assembly using test stand assembly Part No. 10898928 (fig. 3-248). Testing of fuel injection pump advance assembly is required on all units that have been repaired to insure optimum engine preformance. This testing will be accomplished prior to assembly of the engine rear fan and accessory drive housing assembly. The test stand is designed to check and bench test the advance characteristics of the fuel injection pump advance assembly, under conditions simulating engine operation over an operating range of 200 to 2600 RPM.

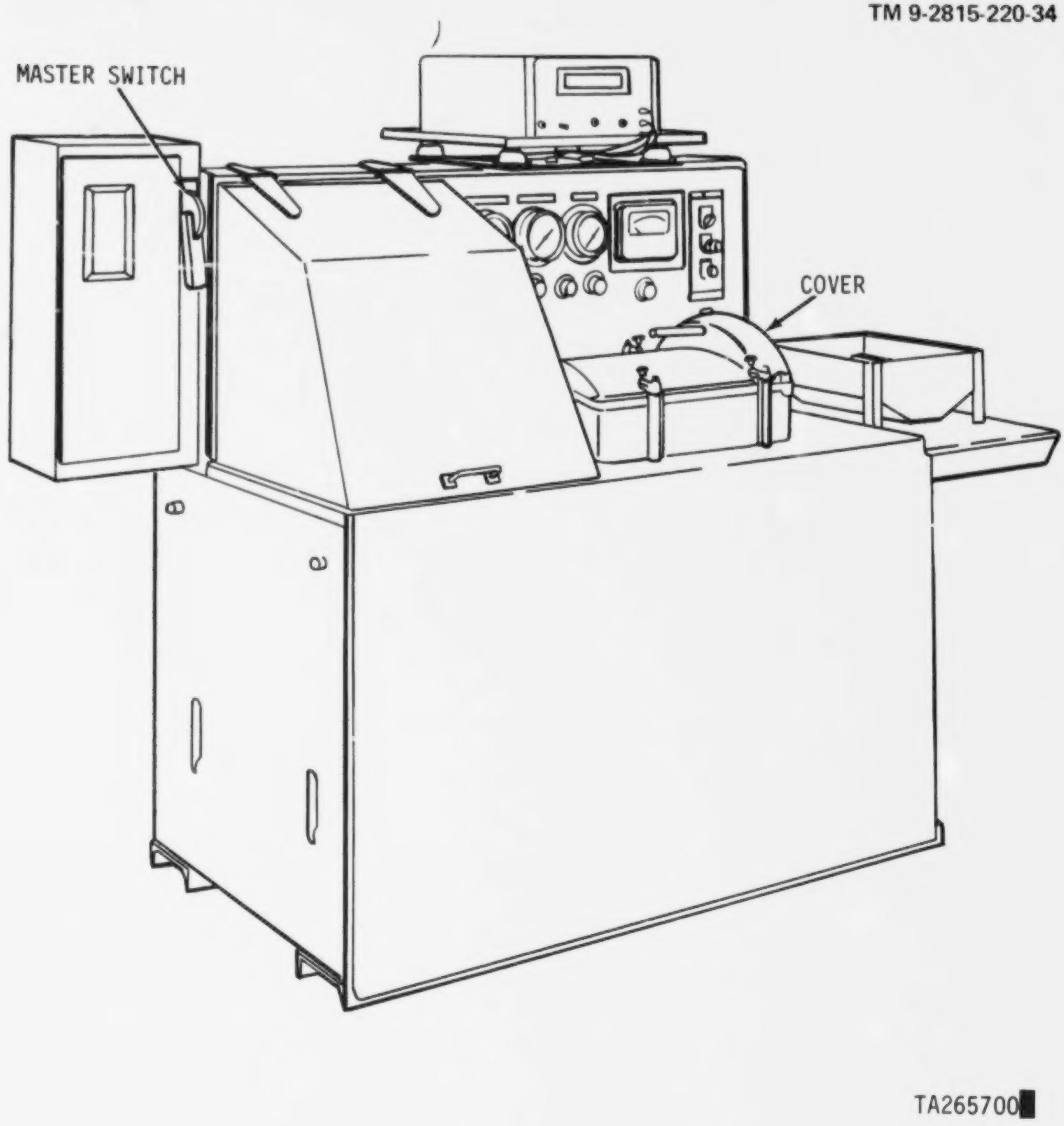

MASTER SWITCH
COVER
TA265700

Figure 3-248. Test stand assembly.

(2) Check fuel level and oil level gages (fig. 3-249). Fill supply tank(s) if either gage indicates less than half full (use oil, specification MIL-L-45199 (Grade 30) or fuel, specification VV-L-800).

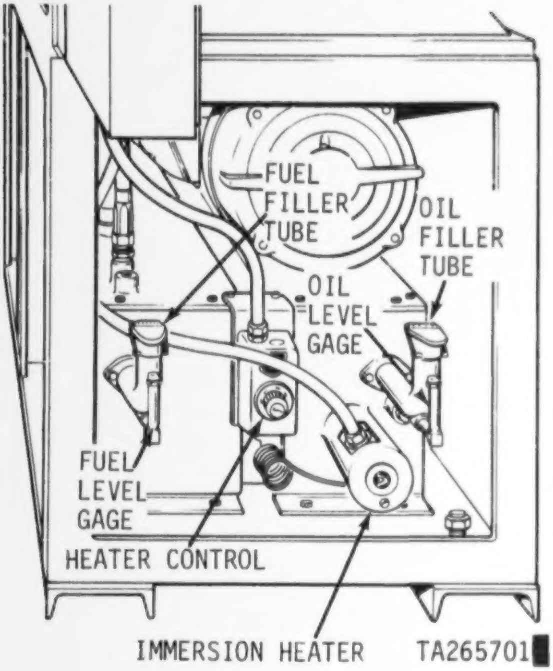
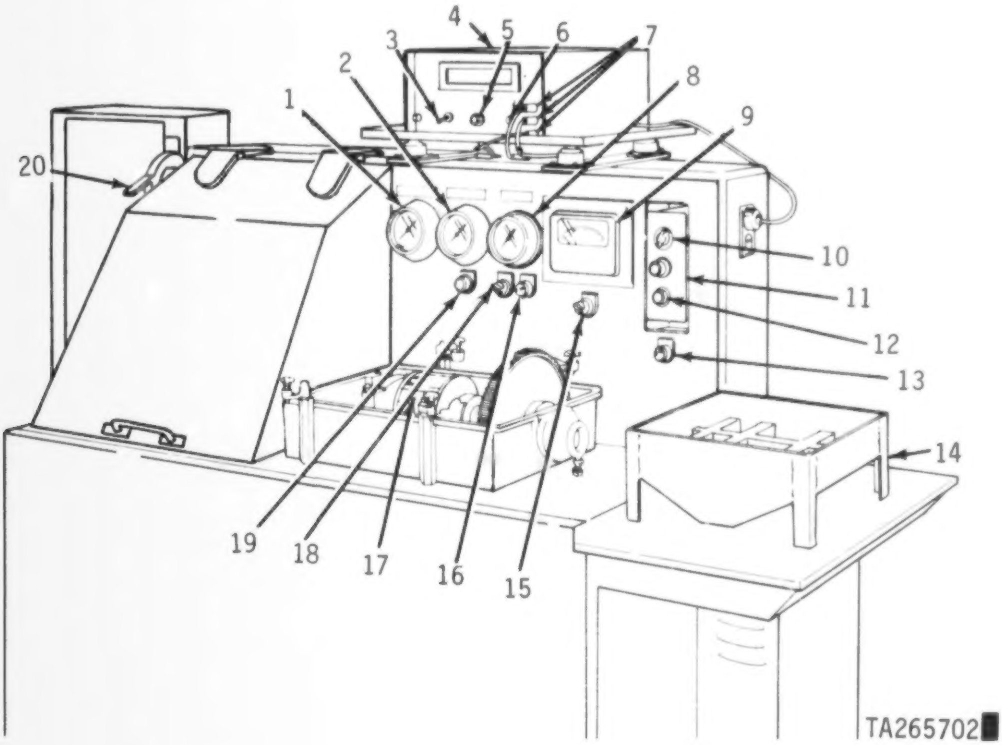

FUEL FILLER TUBE
OIL FILLER TUBE
OIL LEVEL GAGE
FUEL LEVEL GAGE
HEATER CONTROL
IMMERSION HEATER
TA265701

Figure 3-249. Test stand heater control and supply tanks.

(3) Check to ensure that the master switch, oil heater switch, jog run (clutch engage) switch, and the motor switch are all in the "OFF" position, and that the speed regulator control is at zero (0).

(4) Turn master switch handle to the "ON" position. The power indicator light should be on. If power indicator light does not light, press the reset buttons. If light does not come on, investigate and correct the deficiency before starting.

(5) Turn oil heater (thermostat) control, figure 3-249, to a setting of 200 degrees and turn oil heater switch, (18, fig. 3-250) "ON". The oil heater indicator lamp should light when the heater switch is turned on, and should go out when the oil reaches the selected oil temperature heater control setting (200 degrees).


1
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TA265702

Figure 3-250. Test stand and advance assembly with coupling guard and housing cover removed.

LEGEND for fig. 3-250:

1 Fuel pressure indicator gage
2 Oil pressure indicator gage
3 Electronic counter switch
4 Electronic counter
5 Fuse
6 Reset button
7 Magnetic pickup cable
8 Oil temperature dial thermometer
9 Electronic tachometer
10 Speed regulator control
11 Jog run switch (clutch engage)
12 Stop switch (clutch disengage)
13 Power indicator light
14 Drain tank
15 Motor switch
16 Heat indicator light
17 Fuel injector advance assembly
18 Oil heater switch
19 Oil drain push switch
20 Master switch

(6) Turn the electronic counter switch, (3), "ON". The electronic components in the counter will reach operating temperature by the time the test is begun.

(7) Loosen fasteners and remove fuel injection pump drive housing cover from top of test stand. Remove the two bearing caps (fig. 3-251) and intermediate bearing support from the mounting fixture.

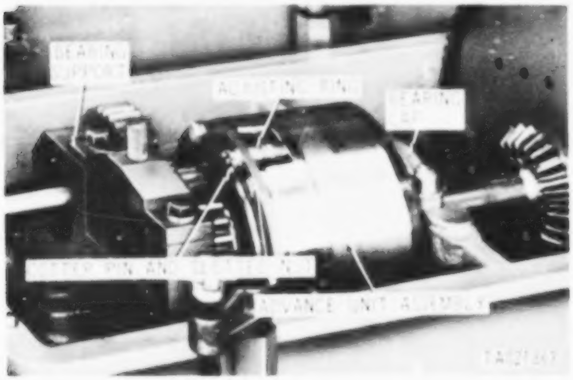


Figure 3-251. Fuel injection pump advance assembly mounting points.

(8) Install retaining ring on test stand oil retaining shaft. Install short (stub) end of oil retaining shaft in driven (small) end of the advance assembly. Install support over bearing on large gear end of advance assembly and install advance assembly in bearing supports of mounting fixture and secure with hardware removed above. Install drive housing cover and secure with fasteners.

CAUTION

The fuel injection pump advance assembly drive housing cover must always be installed and secured before operating test stand.

(8.1) Turn motor switch (15, fig. 3-250) "ON".

(9) Push jog run (clutch engage) switch to engage eddy current clutch and turn speed regulator control to obtain advance assembly speed of 300 rpm on tachometer. Turn speed regulator control clockwise to increase rpm.

(10) Observe oil and fuel pressure indicator gages (1 and 2, fig. 3-250). These gages should register more than zero (0); however, maximum pressures will not be evident until a speed of 2000 rpm is obtained.

CAUTION

Turn master switch handle "OFF" if there is no indication of oil or fuel pressure on the gages. Investigate and correct the deficiency before starting the test.

(11) Operate test stand at 300 rpm until the oil temperature dial thermometer (8) stabilizes at 200 degrees. It may require several minutes to warm the entire system to operating temperature. Note and record electronic counter (4) reading (illuminated decimal digits on the front of the counter panel).

(12) Press oil drain push switch, located immediately below the oil pressure indicator gage. The gage should register zero (0) psi with the switch depressed. Observe the counter reading. If the counter has changed more than one (1) degree, the advance assembly requires adjustment.

(13) Release oil pressure drain switch. Turn speed regulator control (10) clockwise to increase the speed to 600 rpm. Note and record the counter reading at each 200 rpm increment increase, beginning at 600 rpm and continue through to 2600 rpm.

(14) Reduce speed to 600 rpm and recheck counter reading. If this reading does not check with the original reading repeat the test. Check the readings taken at each 200 rpm increase against similar points on the approved advance unit curve (fig. 3-252). If the recorded advance readings fall within the prescribed limits on the curve, the test is complete. If the advance readings do not meet the curve limits, proceed with step (17) below.

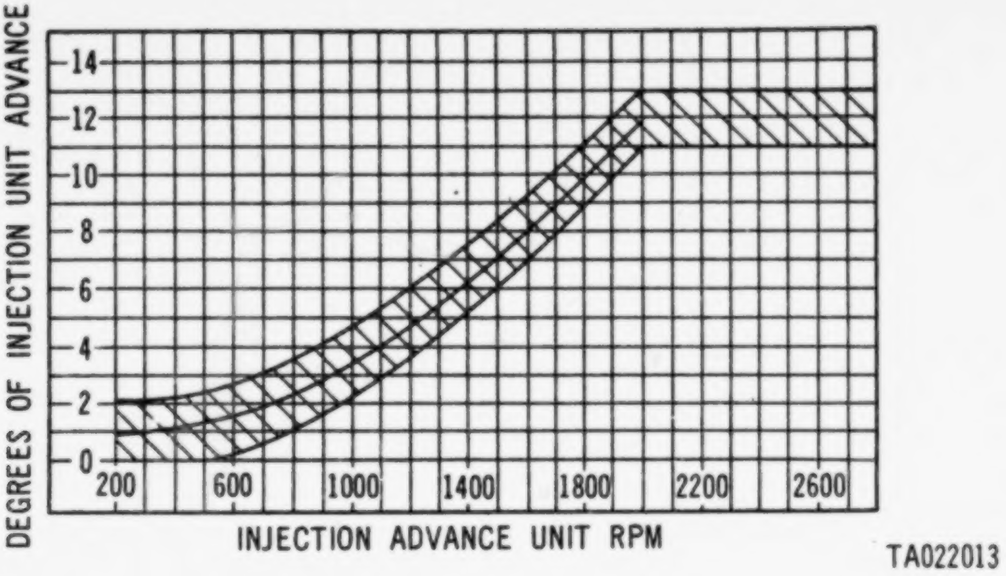


Figure 3-252. Fuel injector advance unit curve.

(15) Turn speed regulator control (10, fig. 3-250) to zero (0), to reduce speed, and counter switch, motor switch, and master switch handle to the "OFF" position.

WARNING

Injection pump advance assembly will be hot following test. Operator should wear gloves when removing unit from test stand.

(16) Loosen fasteners and remove cover. Remove bearing caps and remove unit from bench. Remove oil transfer shaft. Place injection advance assembly on oil drain tray with small gear end up to drain and cool. Place advance assembly in a clean dirt free container, preferable a polyethelene bag, for storage.

(17) Repeats (9) through (14) above to check previous readings. If advance assembly fails to pass the test, it must be adjusted. Note whether advance assembly advances too soon or too late. Either condition can normally be corrected by rotating the advance flywheel adjusting ring (fig. 3-251).

NOTE

The advance assembly should be retarded slightly if the advance varies more than 2 degrees at 300 rpm when the oil pressure drain button is depressed. This variance indicates the mechanical retard stop is not in phase with the hydraulic valve.

(18) Push speed control stop switch to disengage eddy current clutch. Turn counter, motor, and motor starter off.

(19) Loosen fasteners and remove cover. Remove two cotter pins, and loosen the two slotted nuts enough to permit adjusting ring rotation (fig. 3-251).

NOTE

Do not turn the adjusting ring more than 1/16 of an inch during any one adjustment.

(20) Rotate the adjusting ring (fig. 3-251) 1/16-inch toward the rear of the bench (retard position) if the advance assembly advanced too soon. Move the adjusting ring 1/16-inch in the opposite direction (advance position) toward operator, if the advance assembly advanced too late. Tighten the slotted nuts, install cover and repeat (3) through (14), above. When advance readings are within the prescribed limits, the advance assembly may be removed from the bench as outlined in (16) above. Secure the adjusting ring slotted nuts with cotter pins.

NOTE

If the advance assembly cannot be properly adjusted as outlined above, the flyweight springs must be checked in accordance with the limits specified in table 3-24.

d. Rear Fan and Accessory Drive Housing.

(1) Install flywheel end fan drive shaft (6, fig. 3-230) in injection automatic advance assembly (43).

(2) Position original shims (9) on end of inner bearing race (side opposite bearing trade mark) of rear fan drive bevel gearshaft ball bearing (10). Measure total thickness of bearing race and shim, from shim on inner race to face of outer race, with end play removed. Thickness should be from 0.7891 inch minimum to 0.7911 inch maximum (fig. 3-253). When total thickness is more than 0.7911 inch, strip 0.002 inch thick lamination from the shim pack until the correct thickness is

obtained. When total thickness is less than 0.7891 inch, add 0.002 inch thick shims (stripped from a new shim pack as necessary).

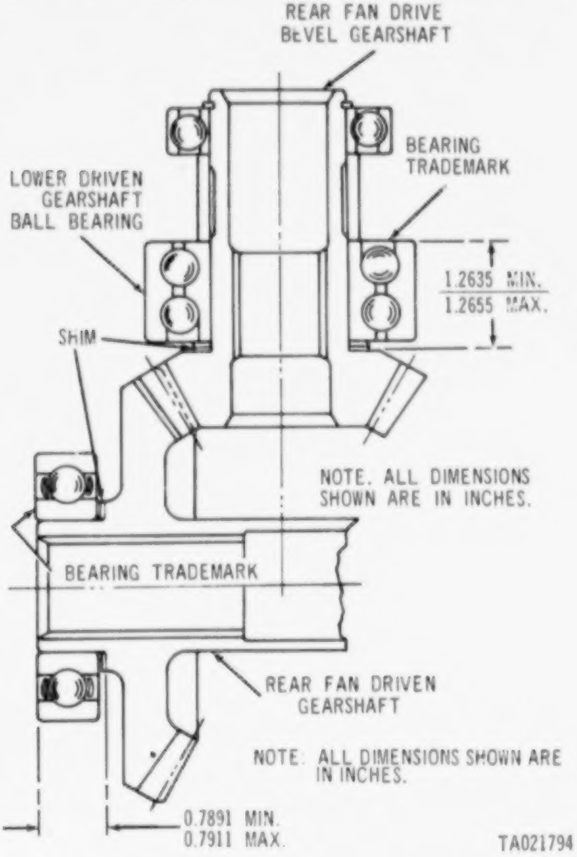

REAR FAN DRIVE BEVEL GEARSHAFT
BEARING TRADEMARK
LOWER DRIVEN GEARSHAFT BALL BEARING
1.2635 MIN.
1.2655 MAX.
SHIM
NOTE. ALL DIMENSIONS SHOWN ARE IN INCHES.
BEARING TRADEMARK
REAR FAN DRIVEN GEARSHAFT
NOTE: ALL DIMENSIONS SHOWN ARE IN INCHES.
0.7891 MIN.
0.7911 MAX.
TA021794

Figure 3-253. Determining shim thickness for rear fan driven bevel gearshaft and rear fan drive gearshaft.

(3) Position shim (9, fig. 3-230) of predetermined thickness (fig. 3-253) over bearing hub of rear fan drive bevel gearshaft (8, fig. 3-230) and press rear fan drive bevel gearshaft ball bearing (10) on gearshaft. Install bearing support (11) on ball bearing and install assembled fan drive bevel gearshaft on injection pump advance assembly.

(4) Position fuel injection pump gearshaft (fig. 3-254) in an arbor press, and position bearing spacer with chamfer up (toward threaded end of shaft). Press ball bearing on gearshaft using pipe of a suitable size as an improvised pressing arbor.

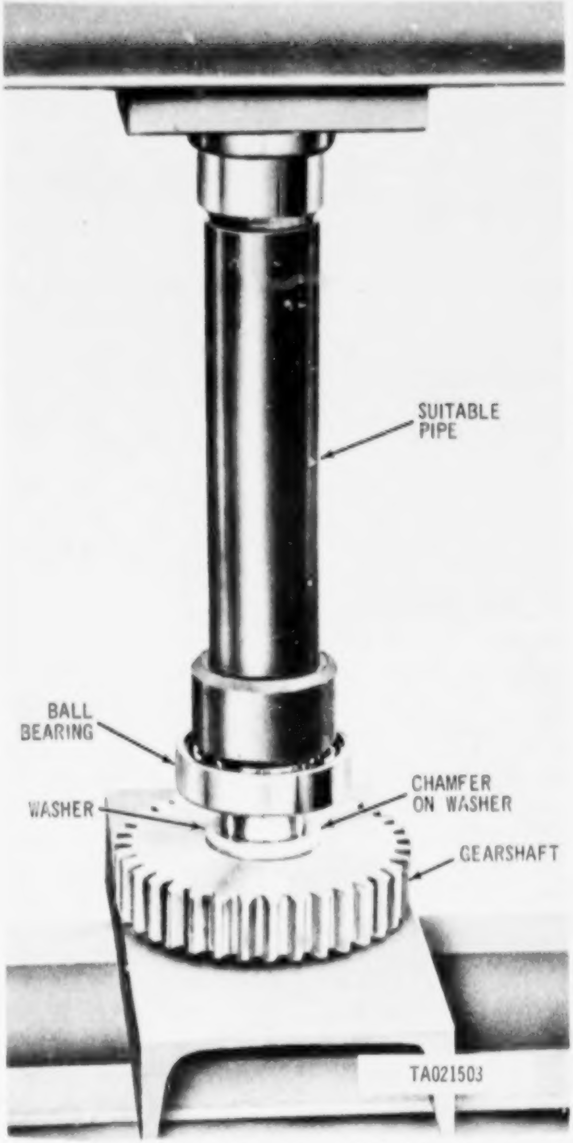

SUITABLE PIPE
BALL BEARING
CHAMFER ON WASHER
WASHER
GEARSHAFT
TA021503

Figure 3-254. Pressing driven gearshaft ball bearing on spur gearshaft.

(5) Install fuel injection pump driven gearshaft needle bearing (6, fig. 3-231) in rear fan drive housing (4) and secure with retaining ring (7). Install fuel injection pump gearshaft oil seal (8) in rear fan drive housing (4). Install fuel injection pump gearshaft (50) with bearing (52) in rear fan drive housing (4).

(6) Apply a thin coat of gasket cement Specification MIL-C-10523 (ORD) on the rear fan drive housing (2, fig. 3-230), install accessory drive housing (51) on rear fan drive housing and secure with seven self-locking nuts (55) and flat washers (56). Install three pipe plugs (2, 40 and 54, fig. 3-231) in rear fan drive housing and pipe plug(31)in accessory drive housing.

(7) Install woodruff key (56) in fuel injection pump gearshaft (50). Install fuel injection pump coupling hub (10, fig. 3-232), ring (9) and sleeve (4) on gearshaft as an assembly. Secure coupling assembly to rearshaft with plain nut (12) and lockwasher (11). Torque tighten nut to 900 pound-inch.

NOTE

The splined coupling halves are a matched set. Make certain the coupling half being installed matches the coupling half on the fuel injection pump.

(8) Position original shims (43, fig. 3-231) on end of inner bearing (side opposite bearing trade mark) of lower driven gearshaft ball bearing (13). Measure the total thickness of bearing race and shim, from shim on inner race to upper face of outer race with end play removed. Thickness should be from 1.2635 inch minimum to 1.2655 maximum. When total thickness is greater than 1.2655 inch, strip 0.002 inch thick laminations from the shim pack until the correct thickness is obtained. When total thickness is less than 1.2635 inch add 0.002 inch thick shims (stripped from a new shim pack) as necessary. Figure 3-253 illustrates shim location and measuring points.

(9) Position shim (43, fig. 3-231) of predetermined thickness on inner race of lower driven gearshaft ball bearing (13) and press fan driven bevel gearshaft (17) into ball bearing. Install bearing spacer (12) on fan driven gearshaft and start upper driven gearshaft ball bearing (11) on gearshaft and press gearshaft into ball bearing. Secure upper ball bearing on gearshaft with retaining ring (10).

(10) Install assembled fan driven gearshaft, in rear fan drive housing (4) and secure with bolt (16) new key washer (15) and lock plate (14). Bend tab on washer.

(11) Install oil transfer plug (25) in camshaft drive gearshaft (26). Install key washers (24) and gearshaft plug (23), torque tighten plug to 1300-1400 pound-inches and bend tab on washer to secure plug.

(12) Install a new preformed packing (35) on right camshaft drive inner support (36). Install camshaft drive gearshaft assembly (22) in accessory drive housing (20) and install support in housing and on gearshaft assembly. Secure support to accessory drive housing with three self-locking nuts (38) and flat washers (37). Install left support and gearshaft in the same manner.

e. Rear Fan and Accessory Drive Housing. Assemble rear fan drive clutch as outlined in paragraph 3-94.

f. Clutch Cover Bearing and Vertical Drive Shaft Oil Seal. Install vertical drive shaft oil seal as outlined in paragraph 3-94. Install clutch cover bearing and clutch cover on clutch assembly as outlined in paragraph 3-94.

g. Rear Fan and Accessory Drive Housing Assembly.

NOTE

Before installing assembled fuel injection advance assembly and fan drive bevel gearshaft, check gearshaft backlash and reshim if necessary (fig. 3-239). Be sure bearing cap and accessory drive housing stamped numbers correspond to their proper location before assembling (fig. 3-255).

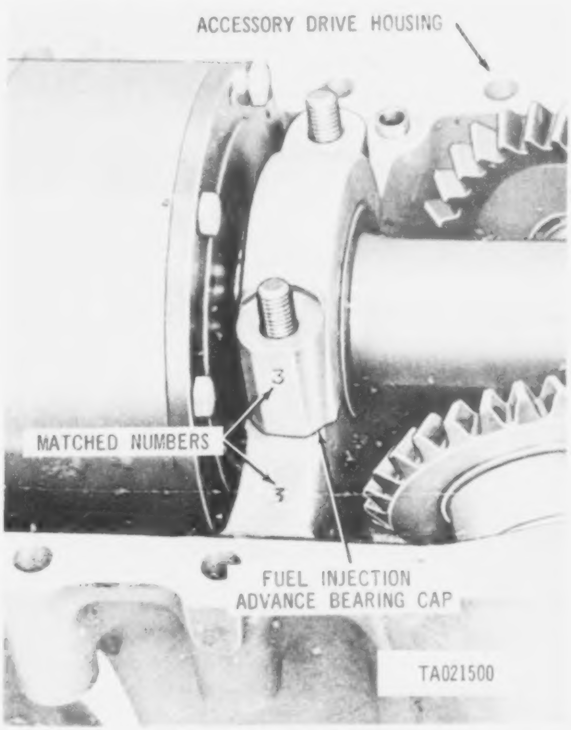


Figure 3-255. Install fuel injection advance bearing cap.

(1) Install assembled injection pump advance assembly (43, fig. 3-230) in rear fan and accessory drive housing and secure front fan drive bevel gearshaft bearing support (11), injection driven gearshaft hub clamp (42) and accessory driven gearshaft hub clamp (46) to rear fan and accessory drive housing with six slotted nuts (45) and cotter pins (44).

(2) Install injection advance bearing cap (29) and secure to accessory drive housing (51) with two cotter pins (32) slotted nuts (31) and flat washers (30). Install four new preformed packings (63) on oil transfer tubes.

(3) Install assembled fan drive housing cover in rear fan drive housing (2) as outlined in paragraph 3-94.

(4) Install fan drive oil seal housing on fan drive housing cover as outlined in paragraph 3-94.

Section XV. REPAIR OF CAMSHAFT AND ASSOCIATED PARTS

3-100. General

a. This section covers the repair of the camshafts and associated parts. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedure. Stud identification information is included in the repair procedures.

b. Repair of right and left camshafts is similar. For instructional purposes repair procedures for the right camshaft will be given with references to the left camshaft only where repair procedures vary.

3-101. Disassembly

a. Remove lifting eye (fig. 3-256), preformed hose and intercylinder hose flange, and separate the lifting eye and flange from hose.

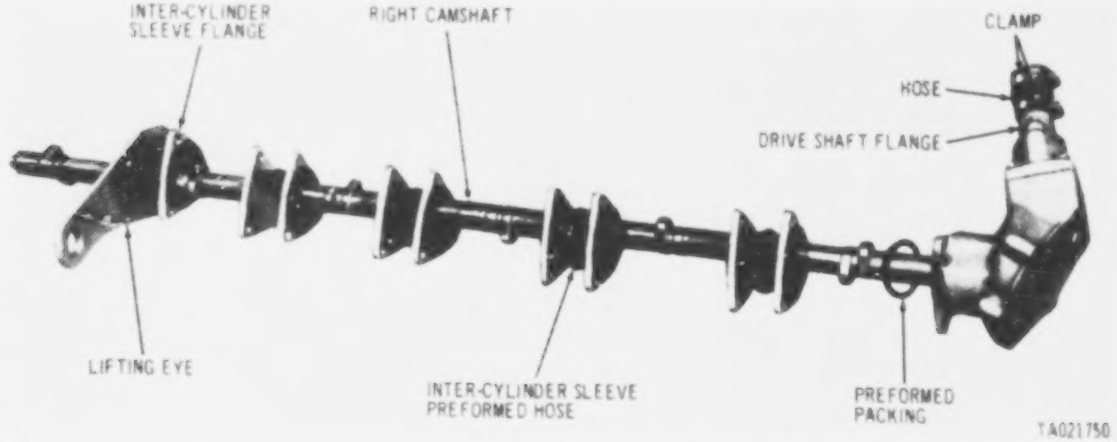


Figure 3-256. Removing or installing lifting eye, intercylinder base flanges, and hoses, model AVDS-1790-2C and AVDS-1790-2D engine.

NOTE

Model AVDS-1790-2DR engines are not equipped with lifting eyes at cylinder Nos. 1R and 1L. Intercylinder hose flanges are used at these locations.

b. Remove four groups of intercylinder hose flanges and preformed hoses and separate the flanges from the hoses.

c. Remove two hose clamps (34, fig. 3-258) and the rubber hose (33) from camshaft drive shaft flange (32).

d. Remove four self-locking nuts (30, fig. 3-258) and flat washers (29) and remove camshaft drive bevel gearshaft adapter (39) and associated parts as an assembly from camshaft gear housing (42).

e. Remove and discard preformed packing (41) from bevel gearshaft adapter (39) and remove and discard preformed packing (28) from oil transfer tube in bevel gearshaft adapter. Remove two bolts (35), lockwashers (36), and flat washers (37) and remove camshaft driveshaft adapter (32) from bevel gearshaft adapter (39). Remove and discard gasket (38).

NOTE

It will be necessary to move the camshaft drive gear away from the camshaft driven gear to gain clearance for removal of camshaft assembly.

f. Remove camshaft (7), bevel gear (6), and gear cover (5) as an assembly from gear housing (42). Remove camshaft drive bevel gearshaft (1) from gear housing.

g. Place assembled camshaft in a soft-jawed vise and cut locking wire and remove eight machine bolts (4) and camshaft cover (5), and bevel gear (6).

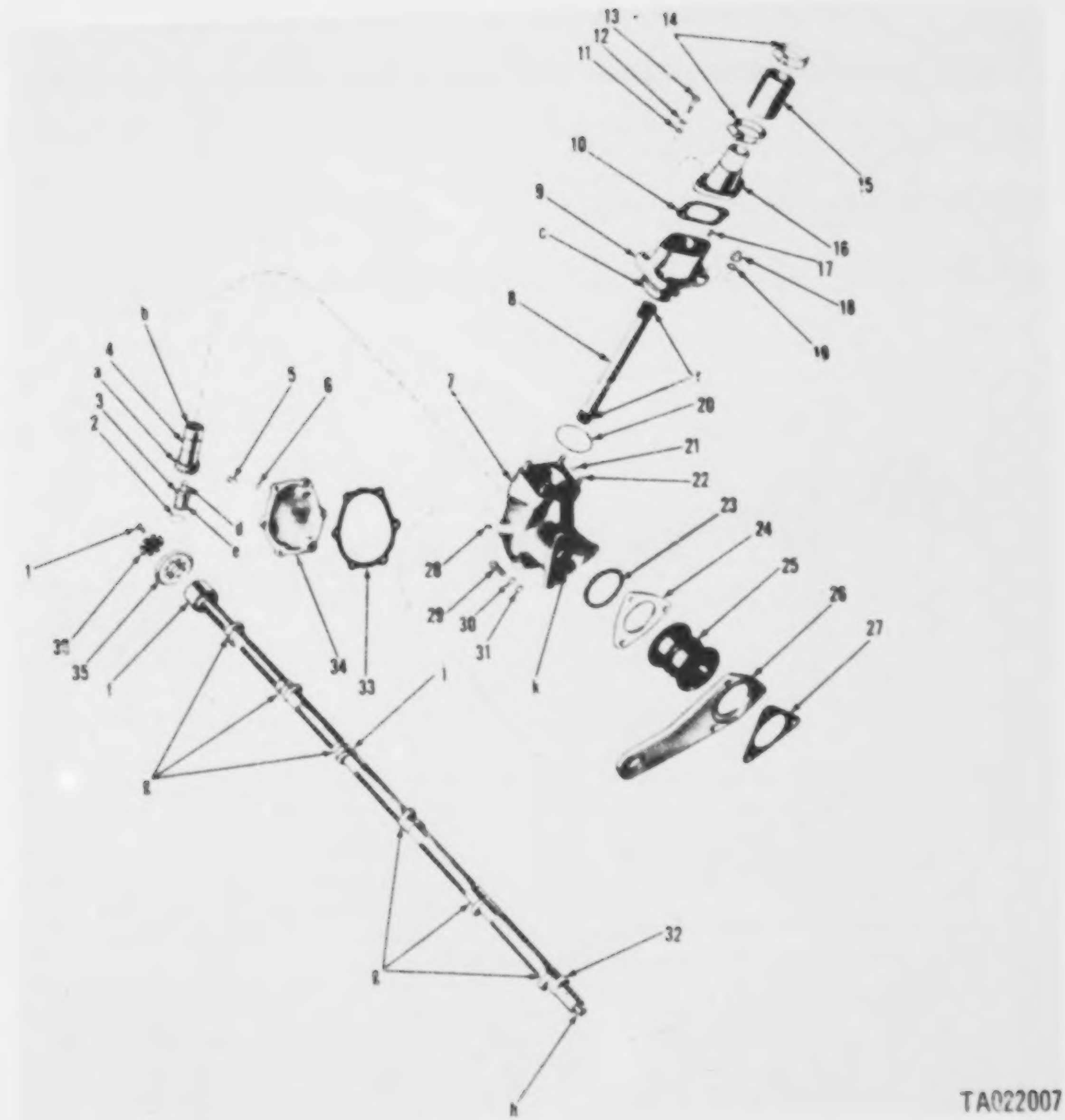
h. Place assembled throttle control cross shaft (26, fig. 3-259) in a soft-jawed vise and remove camshaft end cover plate (22) from ball bearing (23) by carefully tapping on end of plate with a soft hammer.

NOTE

The left camshaft does not have a cover plate assembly.

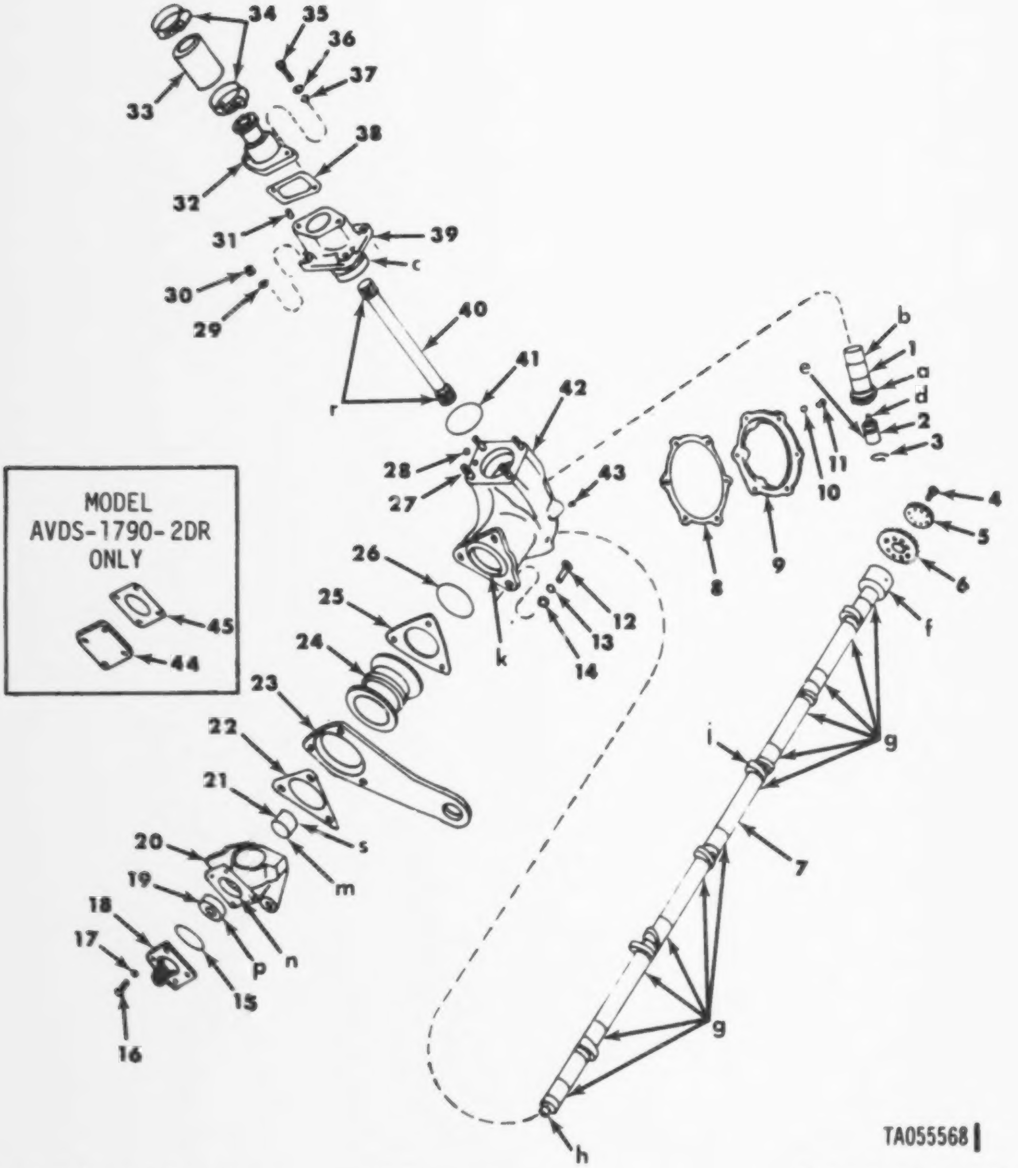
i. Cut locking wire and remove four capscrews (16, fig.3-258) and flat washers (17). Remove tachometer drive adapter (18) from end plate (20) and remove and discard preformed packing (15). Remove oil seal (19).

i.1. Cut locking wire and remove four capscrews



1 Machine bolt
2 Camshaft bevel shaftgear plug retaining ring
3 Camshaft bevel shaftgear plug
4 Camshaft drive bevel gearshaft
5 Capscrew
6 Flat washer
7 Camshaft gear housing
8 Camshaft drive shaft
9 Camshaft drive bevel gearshaft adapter
10 Gasket
11 Flat washer
12 Lockwasher
13 Machine bolt
14 Hose clamp
15 Camshaft drive shaft straight adapter hose
16 Camshaft drive shaft straight adapter
17 Screw thread insert
18 Self-locking nut
19 Flat washer
20 Preformed packing
21 Oil transfer tube preformed packing
22 Camshaft drive bevel gearshaft adapter stud
23 Preformed packing
24 Intercylinder sleeve flange
25 Intercylinder sleeve
26 Engine lifting eye
27 Gasket
28 Screw thread insert
29 Capscrew
30 Lockwasher
31 Flat washer
32 Camshaft
33 Camshaft gear cover gasket
34 Camshaft gear cover
35 Camshaft drive bevel gear
36 Camshaft cover

Figure 3-257. Camshaft and drive gears (left bank) — exploded view.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1 Camshaft drive bevel gearshaft
2 Camshaft bevel shaftgear plug
3 Camshaft bevel shaftgear plug retaining ring
4 Machine bolt
5 Camshaft cover
6 Camshaft drive bevel gear
7 Camshaft
8 Camshaft gear cover gasket
9 Camshaft gear cover
10 Flat washer
11 Capscrew
12 Capscrew
13 Lockwasher
14 Flat washer
15 Preformed packing
16 Capscrew
17 Flat washer
18 Tachometer drive adapter
19 Oil seal
20 Camshaft end cover support
21 Sleeve bearing
22 Gasket
23 Engine lifting eye
24 Intercylinder sleeve
25 Intercylinder sleeve flange
26 Preformed packing
27 Camshaft gear housing stud
28 Preformed packing
29 Flat washer
30 Self-locking nut
31 Screw thread insert
32 Camshaft drive bevel gearshaft adapter
33 Camshaft drive shaft straight adapter hose
34 Hose clamp
35 Machine bolt
36 Lockwasher
37 Flat washer
38 Gasket
39 Camshaft drive bevel gearshaft adapter
40 Camshaft drive shaft
41 Preformed packing
42 Camshaft gear housing
43 Screw thread insert
44 Tachometer drive cover
45 Gasket

Figure 3-258. Camshaft and drive gears (right bank) – exploded view.

(16, fig. 3-258) and flat washers (17). Remove tachometer drive cover (44) and gasket (45). Discard gasket.

3-102. Cleaning

Refer to paragraph 3-36.

3-103. Inspection and Repair

a. General. Refer to paragraph 3-37 and 3-38.

b. Bushings. Inspect bushings type bearings in camshaft end plate to limits specified in repair standards (table 3-26).

c. Studs. Refer to paragraph 3-38*d* and table 3-27 when replacing studs.

d. Camshaft.

(1) Inspect for cracks. Inspect camshaft lobes and bearing surfaces for wear, scuffing and scoring. Check camshafts against limits specified in repair standards (table 3-26). Inspect camshaft for stripped or damaged threads in tapped holes.

(2) Replace camshaft when cracked or when lobes or bearing surfaces are badly worn, scuffed or scored. Replace camshaft when it does not check against limits specified in repair standards (table 3-26). Repair damaged threads in gear hub with a used tap. Remove slight scuffing or scoring from camshaft lobes and bearings with a fine oil stone and polish with corcus cloth dipped in dry-cleaning solvent or mineral spirits paint thinner.

Table 3-26. Camshaft and Drives Repair Standards

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Camshafts	3-258	g	Outside diameter of journal on camshaft.	1.3090	1.3100	1.3085
	3-190	q	Inside diameter of camshaft bearing in cylinder.	1.3115	1.3135	1.3140
	3-190 3-258	q-g	Fit of journal in bearing.	0.0015L	0.0045L	0.0055L
	3-258		Maximum out-of-round of camshaft journal (full indicator reading).	0.0010		0.0020
	3-258		Maximum runout of center journal when supported on end bearing (full indicator reading).	0.0020		0.0150
	3-258	h	Outside diameter of camshaft pilot bearing at end plate.	1.3090	1.3100	*
	3-258	m	Inside diameter of split bushing-type bearing in camshaft end plate.	1.3120	1.3130	*
	3-258	m-h	Fit of camshaft pilot in end plate bushing-type bearing.	0.0020L	0.0040L	*
	3-258	j	Camshaft lobe lift	0.4170	0.4230	0.4140
	3-258	f	Outside diameter of large journal on end of camshaft.	2.4965	2.4975	2.4960
	3-258	k	Inside diameter of bearing surface in camshaft gear housing.	2.5000	2.5010	2.5020
	3.258	k-f	Fit of journal in bearing.	0.0025L	0.0045L	0.0060L
Upper camshaft drive quill bevel gearshafts	3.258	b	Outside diameter of hub on gearshaft.	1.6220	1.6230	1.6210
	3-258	c	Inside diameter of bore in upper adapter.	1.6250	1.6260	1.6270
	3-258	c-b	Fit of hub in adapter bore.	0.0020L	0.0040L	0.0060L
	3-258	a	Inside diameter of hub on gearshaft.	1.2710	1.2720	*
	3-258	e	Outside diameter of upper oil transfer plug.	1.2700	1.2705	*
	3-258	e-a	Fit of plug in hub	0.0005L	0.0020L	*
Camshaft drive quills	3.258	r	Inside diameter of camshaft drive quill (both ends).	0.6292	0.6300	0.6315
Camshaft drive quills	3-258	d	Spherical outside diameter of upper oil transfer plug.	0.6275	0.6280	0.6265
	3-258	r-d	Fit of upper transfer plug in quill.	0.0012L	0.0025L	0.0050L
	3-231	w	Spherical outside diameter of lower oil transfer plug.	0.6275	0.6280	0.6265

See foot note at end of table.

Table 3-26. Camshaft and Drives Repair Standards — Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Camshaft end plate	3-231 3-258	w-r	Fit of lower transplug in quill.	0.0012L	0.0025L	0.0050L
	3-258	p	Outside diameter of oil seal.	1.5010	1.5050	*
	3-258	n	Inside diameter of camshaft end plate.	1.4990	1.5000	*
	3-258	n-p	Fit of oil seal in plate bore.	0.0010T	0.0060T	*

Refer to paragraph 3-37*c* for explanation of symbols.

Table 3-27. Camshaft Drive Housing Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-258	27	1-5/32	8	3/8-16 (15/16) x 3/8-24 (13/16) x 1-15/16

3-104. Assembly

a. Install bearing (21, fig. 3-258) and oil seal (19) in camshaft end cover plate (20). Install a new preformed packing (15) on tachometer drive adapter (18) and secure drive adapter on cover plate with four capscrews (16) and flat washers (17). Secure capscrews with locking wire.

*a.*1. Install new gasket (45, fig. 3-258) and tachometer drive cover (44) on camshaft end cover support (20) and secure with four flat washers (17) and capscrews (16). Install locking wire.

NOTE

The left camshaft does not have a cover plate assembly.

b. Place right camshaft (7, fig. 3-258) in a soft-jawed vise and install bevel gear (6) and camshaft cover (5). Secure cover and gear to camshaft with eight machine bolts (4) and secure bolts with locking wire.

c. Install camshaft drive bevel gearshaft (1) and assembled camshaft (7) in gear housing (42).

NOTE

It will be necessary to move the bevel gearshaft away from the camshaft drive gear to gain clearance for installation of camshaft assembly.

d. Using a new gasket (38) install camshaft drive shaft adapter (32) or bevel gearshaft adapter (39) and secure with two bolts (35) lockwashers (36) and flat washers (37). Install a new preformed packing (28) on oil transfer tube in bevel gearshaft adapter and a new preformed packing (41) on bevel gearshaft adapter.

e. Install assembled bevel gearshaft adapter (39) on camshaft gear housing (42) and secure with four selflocking nuts (30) and flat washers (29).

f. Install hose (33) on camshaft drive shaft adapter and secure with two hose clamps (34).

g. Position two intercylinder hose flanges (fig. 3-256) on each of four preformed hoses and install hose assemblies on camshaft.

h. Position lifting eye and remaining intercylinder hose flange on remaining preformed hose and install hose assembly on camshaft.

Section XVI. REPAIR OF THROTTLE CONTROL CROSS SHA MANUAL FUEL SHUTOFF ROD, AND ASSOCIATED PART

3-105. General

This section covers the repair of the throttle control cross shaft, fuel injection pump linkage, manual fuel shutoff rod, and associated parts. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedure.

3-106. Disassembly

a. Place the assembled throttle control cross shaft and fuel injection pump linkage in a soft-jawed vise and remove camshaft end plate ball bearing retaining ring (45, fig. 3-259). Using a suitable puller, remove camshaft end plate ball bearing (23).

b. Remove camshaft end plate bearing inner retaining ring (46). Remove cap screw (24) and lockwasher (25) and remove throttle lever assembly (47) and woodruff key (48) from throttle control cross shaft (26).

c. Remove cross shaft bracket bearing retaining ring (33) and using a suitable puller, remove throttle control cross shaft bracket (35), bearing (51) and retaining rings (34) as an assembly. Remove inner cross shaft bracket bearing retaining ring (33) from cross shaft.

d. Remove cross shaft lever bearing retaining ring (52) and using a suitable puller, remove cross shaft governor control lever assembly (56), two bearings (51), and two retaining rings (53) as an assembly.

e. Remove retaining ring (52) and two throttle shock spring flat washers (57) and shock spring (58). Remove capscrew (44) and lockwasher (43) and remove throttle control lever assembly (42). Remove woodruff key (49 from cross shaft (26).

f. Remove two retaining rings (32) and two spacers (31) and remove manual fuel shut off control lever assembly (27) from cross shaft (26.)

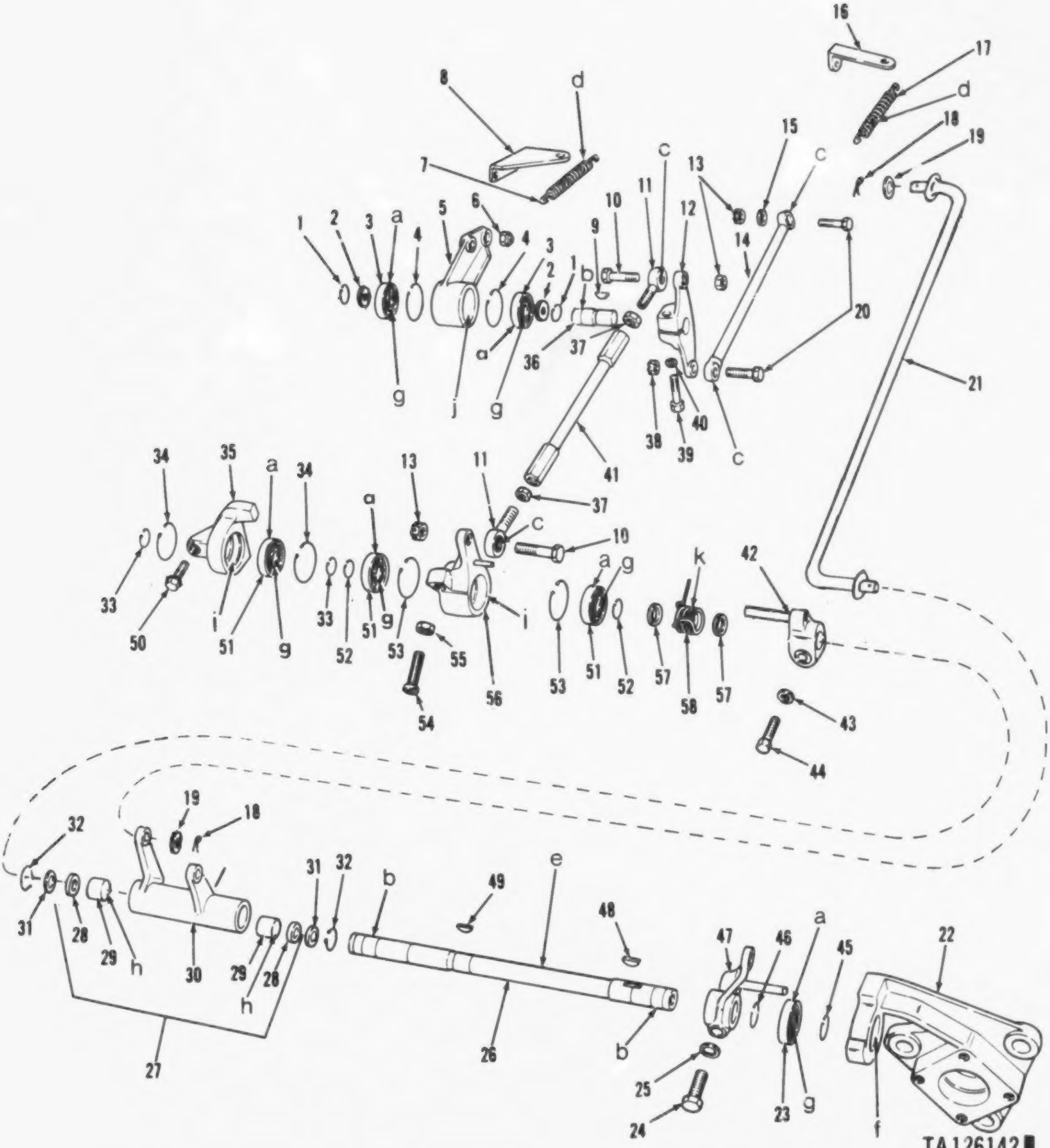
g. Remove capscrew (39), lockwasher (40), and remove intermediate governor control lever (12) and woodruff key (9) from governor control lever bearing shaft (36). Remove two retaining rings (1) and remove two dust shields (2) and intermediate governor control lever support (5), two ball bearings (3), and two retaining rings (4) from bearing shaft as an assembly. Remove the two retaining rings, dust shields and ball bearings from the support.

h. Remove two retaining rings (33) and the ball bearing (51) from the throttle control cross shaft bracket (35). Remove two ball bearings (51) and two retaining rings (53) from the cross shaft governor control lever assembly (56). Loosen two nuts (37) and remove the left hand and right hand rod end bearings (11) from the governor control rod (41).

NOTE

The rod bearings on the intermediate governor lever connection link are pinned and are not to be disassembled.

i. Remove two oil seals (28) and two bearings (29) from manual fuel shutoff lever (30).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1 Retaining ring
2 Shield
3 Ball Bearing
4 Retaining ring
5 Intermediate governor control lever bearing support
6 Self-locking nut
7 Throttle control lever return spring
8 Throttle control lever return spring, angle bracket
9 Woodruff key
10 Machine bolt
11 Rod end bearing
12 Intermediate governor control lever
13 Self-locking nut
14 Intermediate governor lever connecting link
15 Flat washer
16 Manual fuel shutoff spring angle bracket
17 Manual fuel shutoff spring
18 Cotter key
19 Flat washer
20 Machine bolt

Figure 3-259. Throttle linkage, manual shutoff and associated parts.

LEGEND for fig. 3-259 continued:

21 Manual fuel shutoff control rod
22 Camshaft end cover plate
23 Ball bearing
24 Capscrew
25 Lockwasher
26 Throttle control cross shaft
27 Manual fuel shutoff control lever assembly
28 Seal
29 Bearing
30 Lever
31 Spacer
32 Retaining ring
33 Retaining ring
34 Retaining ring
35 Throttle control cross shaft bracket
36 Governor control lever bearing shaft
37 Plain nut
38 Slotted nut
39 Capscrew
40 Lockwasher
41 Governor control rod
42 Throttle control lever assembly
43 Lockwasher
44 Capscrew
45 Retaining ring
46 Retaining ring
47 Throttle lever assembly
48 Woodruff key
49 Woodruff key
50 Assembled washer bolt
51 Ball bearing
52 Retaining ring
53 Retaining ring
54 Stop screw
55 Plain nut
56 Cross shaft governor control lever assembly
57 Flat washer
58 Throttle helical shock spring

3-107. Cleaning

Refer to paragraph 3-36.

3-108. Inspection and Repair

Refer to paragraphs 3-37 and 3-38 for procedure and table 3-28 for repair standards.

Table 3-28. Throttle Control Cross Shaft and Fuel Injection Pump Linkage Repair Standards

Component	Fig. No.	Ref. Letter	Point of Measurement	Sizes and fits of new parts		Wear limits
Throttle control linkage.	3-259	a	Outside diameter of bearings.	1.3745	1.3750	*
	3-259	j	Inside diameter of bearing bores.	1.3740	1.3746	1.3751
	3-259	f	Inside diameter or bearing bore in camshaft end plate.	1.3755	1.3761	1.3763
	3-259	j-a	Fit of bearing in bore	0.0001L	0.0010T	0.0006L
	3-259 3-259	f-a	Fit of bearing in end plate bearing bore.	0.0005L	0.0016L	0.0018L
	3-259	g	Inside diameter of bearings.	0.6247	0.6250	*
	3-259	b	Outside diameter of governor control lever bearing support and throttle control cross shaft.	0.6249	0.6252	0.6246
	3-259	b-g	Fit of bearing on support and cross shaft.	0.0001L	0.0005T	0.0004L
	3-259	c	Clearance between ball and socket (parallel to thread shank).	0.0005L	0.0015L	0.0020L
	3-259	k	Spring helical torsion:			
			Approximate free length of spring.	0.750 inch		*
			Torque at installed position (45 degrees of windup).	30 lbs per inch.		
	3-258	s	Outside diameter of split bushing-type bearing (to be press fit .0035T - .0060T in bore of camshaft end plate, then machine inside diameter to 1.3120-1.3130).			
	3-258	m	Inside diameter of split bushing-type bearing (installed).	1.3120	1.3130	*
	3-258	h	Outside diameter of camshaft pilot bearing at end plate.	1.3090	1.3100	*
	3-258	h-m	Fit of camshaft pilot in end plate bushing-type bearing.	0.0020L	0.0040L	*
	3-258	p	Outside diameter of oil seal.	1.5010	1.5050	*
	3-258	n	Inside diameter of oil seal bore in camshaft end plate.	1.4990	1.5000	*
	3-258	n-p	Fit of oil seal in bore of end plate.	0.0010T	0.0060T	*

See foot note at end of table.

Table 3-28. Throttle Control Cross Shaft and Fuel Injection Pump Linkage Repair Standards — Continued

Component	Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Throttle control linkage	3-259	h	Inside diameter of sleeve bearing installed in manual fuel shutoff level	0.6270	0.6280	0.6295
	3-259	e	Outside diameter of throttle cross shaft at manual fuel shutoff lever	0.6232	0.6252	0.6217 0.6220
	3-259	h-e	Fit of shaft in sleeve bearing	0.0017L	0.0028L	0.0053L
	3-259	d	Helical extension spring free length (inside loops).	2.4700		
			Tension limits:	3.09 lbs ± .25 lbs at 3.31 in. 5.43 lbs ± .30 lbs at 4.25 in.		* *
			Maximum extended length without set (inside loops)	4.75 in.		

Refer to paragraph 3-37*c* for explanation of symbols.

3-109. Assembly

a. Install two bearings (29, fig. 3-259), one in each end of lever (30). Bearings must be installed 0.250 inch below end surface of lever. Ream bearings to 0.6270 to 0.6290 inch after installation. Clean lever after reaming. Install two plain seals (28), one on each end of lever. Lip of seal must be to the outside. Seal must be installed flush or below end surface of lever.

b. Install the left hand and right hand rod end bearings (11) on the governor control rod (41) and tighten nuts (37). The governor control rod with rod end bearings installed should be approximately 10.92 inches long. Install two retaining rings (53) and ball bearings (51) in cross shaft governor control lever assembly (56). Install ball bearing (51) and two retaining rings (34) in the throttle control cross shaft bracket (35).

c. Install two retaining rings (4) and two ball bearings (3) in intermediate governor control lever support (5). Install governor control lever bearing shaft (36) in assembled control lever and secure with two dust shields (2) and two retaining rings (1). Install woodruff key (9) and intermediate governor control lever (12) on bearing shaft and install capscrew (39) and lockwasher (40) in control lever.

d. Install manual fuel shutoff control lever assembly (27) on cross shaft (26) and secure with two spacers (31) and two retaining rings (32).

e. Install woodruff key (49) and throttle control lever assembly (42) on cross shaft (26) and install capscrew (44) and lockwasher (43) in control lever. Install shock spring flat washer (57) and shock spring (58) on cross shaft with both ends of spring engaging straight pin in control lever assembly (42). Install shock spring washer (57) and retaining ring (52) on cross shaft.

f. Install cross shaft governor control lever assembly (56) on cross shaft (26). Install retaining ring (52).

g. Install inner cross shaft bracket bearing retaining ring (33) on cross shaft (26) and install assembled throttle control cross shaft bracket (35). Install retaining ring (33).

h. Install woodruff key (48) and throttle lever assembly (47) on cross shaft (26). Install capscrew (24) and lockwasher (25) in lever assembly. Install inner bearing retaining ring (46) on cross shaft.

i. Install camshaft end plate ball bearing (23) and ball bearing retaining ring (45).

j. Place assembled throttle control cross shaft (fig. 3-259) in a soft-jawed vise and install assembled camshaft and cover plate (22) on ball bearing (23) by carefully tapping on end plate with a soft hammer.

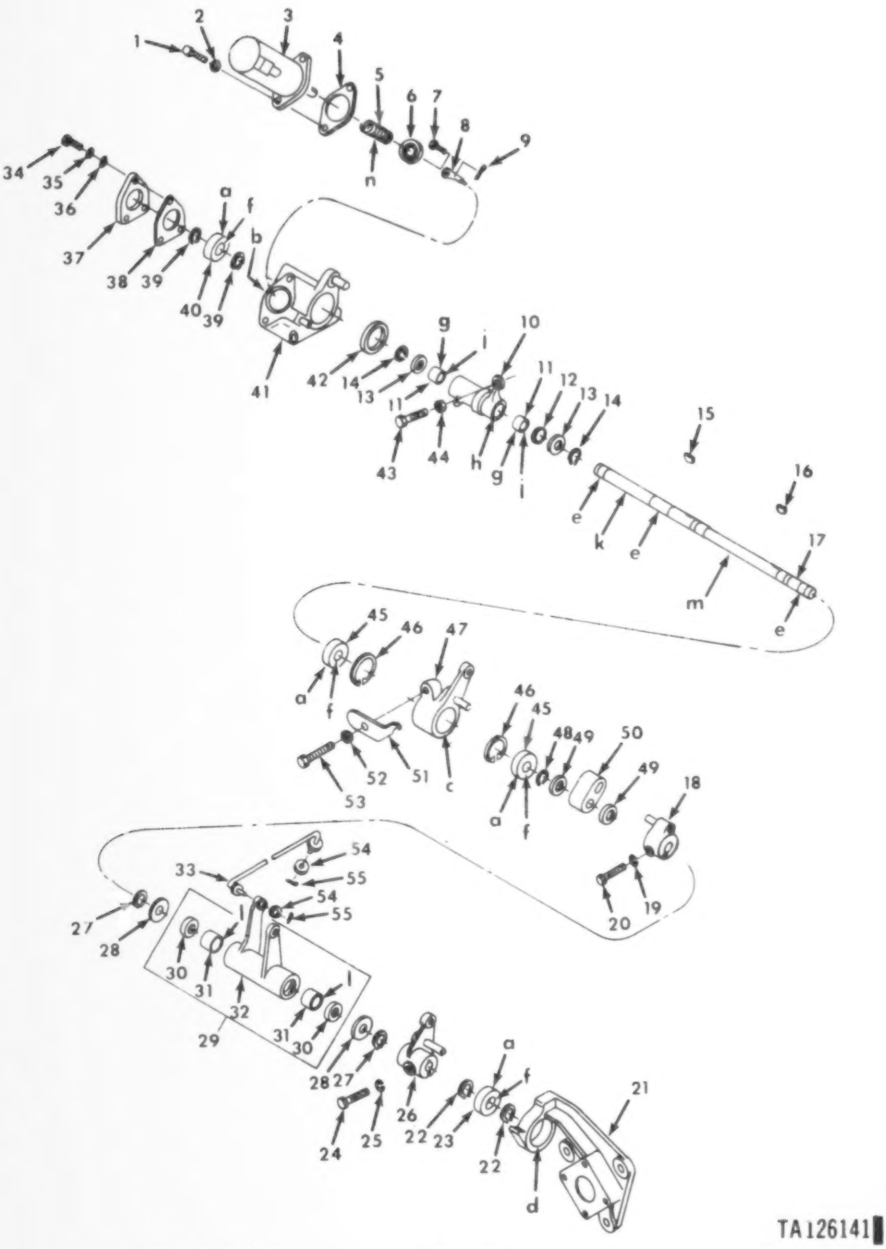
Section XVI.1. REPAIR OF THROTTLE CONTROL CROSS SHAFT, MANUAL FUEL SHUTOFF ROD, AND ASSOCIATED PARTS

3-109.1. General

This section covers the repair of the throttle control cross shaft, fuel injection pump linkage, manual fuel shut-off rod, electrical solenoid controls, and associated parts. Specific instructions on disassembly, cleaning inspection, and assembly accompany the repair operations. Repair standards of individual components follow the inspection procedure.

3-109.2. Disassembly

a. Place the assembled throttle control cross shaft in a soft-jawed vise. Remove camshaft end cover plate (21, fig. 3-259.1). Remove outer annu-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1 Capscrew
2 Lockwasher
3 Electrical solenoid
4 Gasket
5 Compression helical spring
6 Compression spring helical retainer
7 Headed straight pin
8 Solenoid link
9 Cotter pin
10 Inner solenoid control housing
11 Needle roller bearing
12 Encased plain seal
13 Flat washer
14 Retaining ring
15 Woodruff key
16 Woodruff key
17 Throttle control straight shaft
18 Control lever assembly
19 Lockwasher
20 Capscrew
21 Camshaft end cover plate
22 Retaining ring
23 Annular ball bearing
24 Capscrew
25 Lockwasher
26 Throttle lever assembly
27 Retaining ring
28 Flat washer
29 Manual fuel shutoff lever
30 Plain seal
31 Sleeve bearing
32 Control lever
33 Control rod
34 Capscrew
35 Lockwasher
36 Flat washer
37 Access cover
38 Gasket
39 Retaining ring
40 Annular ball bearing
41 Outer solenoid control housing
42 Encased plain seal
43 Machine screw
44 Hexagon plain nut
45 Annular ball bearing
46 Retaining ring
47 Remote control lever
48 Retaining ring
49 Flat washer
50 Throttle control lever lock
51 Angle bracket
52 Hexagon plain nut
53 Machine screw
54 Flat washer
55 Cotter pin

Figure 3-259.1. Throttle linkage, manual shutoff and associated parts, model AVDS-1790-2DR engine.

lar ball bearing retaining ring (22). Using a suitable puller, remove camshaft end plate annular ball bearing (23). Remove inner annular ball bearing retaining ring (22).

b. Remove capscrew (24) and lockwasher (25). Remove throttle lever assembly (26) and Woodruff key (16) from throttle control straight shaft (17).

c. Remove outer retaining ring (27), flat washer (28) and manual fuel shutoff lever (29). Remove inner flat washer (28) and inner retaining ring (27). Remove two plain seals (30) and two sleeve bearings (31) from control lever (32).

d. Remove capscrew (20), lockwasher (19), control lever (18), Woodruff key (15), two flat washers (49), and throttle control lever lock (50) from throttle control straight shaft (17).

e. Loosen hexagon plain nut (52) and remove machine screw (53) and angle bracket (51) from remote control lever (47). Remove retaining ring (48). Using a suitable puller, remove remote control lever (47), two annular ball bearings (45), and two retaining rings (46) as an assembly. Remove annular ball bearings (45) and retaining rings (46) from remote control lever (47).

f. Remove two capscrews (1), lockwashers (2), and remove electrical solenoid (3), by disengaging solenoid link (8) from eye on inner solenoid control housing (10). Remove and discard gasket (4) and cotter pin (9). Remove headed straight pin (7), solenoid link (8), compression spring helical retainer (6), and compression helical spring (5) from electrical solenoid (3).

g. Remove three capscrews (34), lockwashers (35), flat washers (36), and access cover (37) from outer solenoid control housing (41). Remove and discard gasket (38).

h. Loosen hexagon plain nut (44) and remove machine screw (43) from inner solenoid control housing (10). Remove outer retaining ring (14) and flat washer (13) from throttle control straight shaft (17). Slide shaft through inner and outer solenoid control housings until annular ball bearing (40) and retaining rings (39) are exposed. Remove outer retaining ring (39). Using a suitable puller, remove annular ball bearing (40). Remove inner retaining ring (39). Separate inner and outer solenoid control housings and remove outer solenoid control housing (41) and encased plain seal (42) from shaft. Remove encased plain seal (42) from outer solenoid control housing (41). Remove inner retaining ring (14), flat washer (13), and inner solenoid control housing (10), with installed needle roller bearings (11), and encased plain seal (12), from throttle control straight shaft (17). Remove needle roller bearings (11) and encased plain seal (12) from inner solenoid control housing (10).

i. Deleted

j. Remove two hose clamps (2, fig. 3-259.2) and dust and moisture seal boot (3) from yieldable control rod assembly (6). Loosen hexagon plain nut (11) and remove right hand rod end plain bearing (10) from governor control rod (12). Loosen hexagon plain nut (23) and remove left hand rod end plain bearing (24) from governor control rod (12).

k. Remove hexagon head capscrew (9), and lockwasher (8). Remove bell crank (7) and Woodruff key (22) from straight shaft (13). Remove two retaining rings (14). Remove rotating eye bracket (18), two replacement bearing shields (15), two annular ball bearings (16), and two retaining rings (17) from straight shaft (13), as an assembly. Remove two replacement bearing shields (15), two annular ball bearings (16), and two retaining rings (17) from rotating eye bracket (18).

NOTE

The rod bearings on the yieldable control rod assembly are pinned and are not to be disassembled.

3-109.3. Cleaning

Refer to paragraph 3-36.

3-109.4. Inspection and Repair

Refer to paragraphs 3-37 and 3-38 for procedure and tables 3-28.1 and 3-28.2 for repair standards.

3-109.5. Assembly

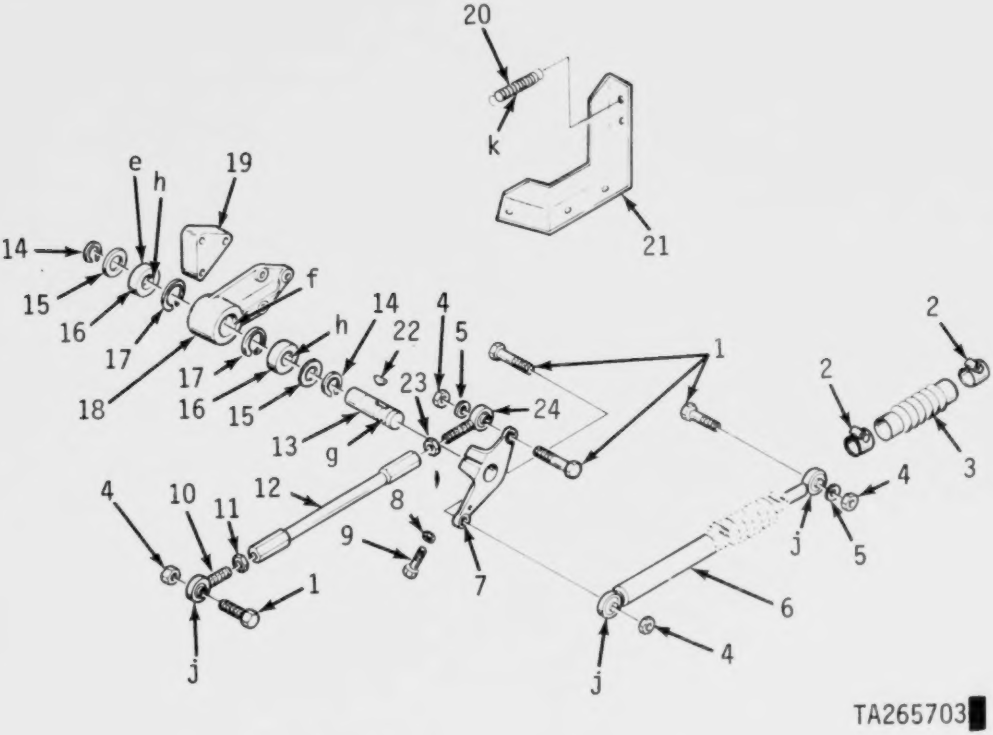
a. Install two sleeve bearings (31, fig. 3-259.1), one in each end of control lever (32). Bearings must be installed 0.250 inch below end surface of lever. Ream bearings to a diameter of 0.6270 — 0.6290 inch, after installation. Clean lever after bearings are reamed, before seals are installed. Install two plain seals (30), one in each end of control lever (32). Lip of seal must be to outside. Seal must be installed flush or below end surface of lever.

b. Install two retaining rings (17, fig. 3-259.2) and two annular ball bearings (16) in rotating eye bracket (18). Install straight shaft (13) in assembled rotating eye bracket and secure with two replacement bearing shields (15) and two retaining rings (14). Install Woodruff key (22) and bell crank (7) on straight shaft (13). Install capscrew (9) and lockwasher (8) in bell crank.

c. Install left hand rod end plain bearing (24) and right hand rod end plain bearing (10) on governor control rod (12). Tighten hexagon plain nuts (11) and (23). The governor control rod should be approximately 10.92 inches long. Install dust and moisture boot (3) and two hose clamps (2) on yieldable control rod assembly (6). Tighten hose clamps.

d. Deleted

e. **Install two needle roller bearings (11, fig. 3-259.1) and one encased plain seal (12) in inner solenoid control housing (10). Install inner solenoid control housing on throttle control straight shaft (17), with two flat washers (13) and two retaining**



1 Hexagon head capscrew
2 Hose clamp
3 Dust and moisture seal boot
4 Flat washer
5 Hexagon self-locking nut
6 Yieldable control rod assembly
7 Bell crank
8 Lockwasher
9 Hexagon head capscrew
10 Rod end plain bearing
11 Hexagon plain nut
12 Governor control rod
13 Straight shaft
14 Retaining ring
15 Replacement bearing shield
16 Annular ball bearing
17 Retaining ring
18 Rotating eye bracket
19 Spacer
20 Extension helical spring
21 Angle bracket
22 Woodruff key
23 Hexagon plain nut
24 Rod end plain bearing (left hand thread)

Figure 3-259.2. Control rods, levers, and associated parts, model AVDS-1790-2DR engine.

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rings (14). Install encased plain seal (42) in outer solenoid control housing assembly (41). Install inner bearing retaining ring (39) on throttle control straight shaft (17). Install outer solenoid control housing assembly (41) on shaft and over end of inner solenoid control housing (10). Install annular ball bearing (40) and outer retaining ring (39). Install access cover (37), new gasket (38), three capscrews (34), three lockwashers (35) and three flat washers (36). Tighten capscrews. Install machine screw (43) and hexagon plain nut (44) in inner solenoid control housing.

f. Install compression helical spring (5), compression spring helical retainer (6), solenoid link (8), headed straight pin (7), and cotter pin (9) on plunger of electrical solenoid (3). Install new gasket (4) and engage end of solenoid link (8) in eye on inner solenoid control housing (10). Install two capscrews (1) and lockwashers (2). Tighten capscrews.

g. Install two retaining rings (46) and two annular ball bearings (45) in remote control lever (47). Install assembled remote control lever on throttle control straight shaft (17) and install retaining ring (48). Install angle bracket (51), machine bolt (53), and hexagon plain nut (52).

h. Install two flat washers (49), throttle control lever lock (50), Woodruff key (15), and control lever assembly (18) on throttle control straight shaft (17). Install capscrew (20) and lockwasher (19) in control lever assembly.

i. Install manual fuel shutoff control lever (29) on throttle control straight shaft (17) and secure with two flat washers (28) and two retaining rings (27).

j. Install Woodruff key (16) and throttle lever assembly (26) on throttle control straight shaft (17). Install capscrew (24) and lockwasher (25) in lever assembly. Install inner bearing retaining ring (22), camshaft end cover plate annular ball bearing (23), and outer bearing retaining ring (22).

k. Place assembled throttle control cross shaft (fig. 3-259.1) in a soft-jawed vise and install camshaft end cover plate (21), by carefully tapping on end plate with a soft hammer.

Table 3-28.1. Throttle Control Cross Shaft and Fuel Injection Pump Linkage Repair Standards

Component	Fig. no.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Throttle control linkage	3-259.1	a	Outside diameter of annual ball bearing	1.3745	1.3750	*
		b	Inside diameter of bearing bore in solenoid control housing	1.3750	1.3756	1.3758
		c	Inside diameter of bearing bore in remote control lever	1.3740	1.3746	1.3751
		d	Inside diameter of bearing bore in camshaft end plate	1.3755	1.3761	1.3763
		b-a	Fit of bearing in solenoid control housing bearing bore	0.0000	0.0011L	0.0013L
		c-a	Fit of bearing in remote control lever bearing bore	0.0001L	0.0010T	0.0006L
Throttle control linkage	3-259.1	d-a	Fit of bearing in camshaft end plate bearing bore	0.0005L	0.0016L	0.0018L
		e	Outside diameter of throttle control straight shaft bearing areas	0.6249	0.6252	0.6246
		f	Inside diameter of annular ball bearings	0.6247	0.6250	*
		e-f	Fit of bearing on throttle control straight shaft	0.0001L	0.0005T	0.0004L
		g	Outside diameter of needle roller bearings	0.8120		*
		h	Inside diameter of solenoid control housing	0.8120	0.8130	*
		g-h	Fit of bearing in bore	0.0000	0.0010L	*
		j	Inside diameter of needle roller bearings	0.6255	0.6265	
Throttle control linkage	3.259.1	k	Outside diameter of throttle control straight shaft	0.6245	0.6252	0.6240

Table 3-28.1. Throttle Control Cross Shaft and Fuel Injection Pump Linkage Repair Standards – Continued

Component	Fig. no.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
		j-k	Fit of bearings on shaft	0.0005L	0.0020L	0.0055L
		l	Inside diameter of sleeve bearing installed in manual fuel shutoff control lever	0.6270	0.6290	0.6305
		m	Outside diameter of throttle control straight shaft at manual fuel shutoff control lever	0.6232	0.6252	0.6217
		l-m	Fit of shaft in sleeve bearing	0.0018L	0.0058L	0.0088L
		n	Solenoid spring			
			Free length	1.50		
			Load at 0.78 inch	2 lbs ± 0.2 lb		
			Solid height	0.375		

Table 3-28.2. Throttle Control Cross Shaft and Fuel Injection Pump Linkage Repair Standards

Component	Fig. no.	Ref. letter	Point of measurement	Sizes and fits of new parts		Wear limits
Throttle control linkage	3-259.2	e	Outside diameter of annular ball bearing	1.3745	1.3750	*
		f	Inside diameter of bearing bore in rotating eye bracket	1.3740	1.3746	1.3751
		e-f	Fit of annular ball bearing in rotating eye bracket bore	0.0001L	0.0010T	0.0006L
Throttle control linkage	3.259.2	g	Outside diameter of governor control lever bearing straight shaft	0.6249	0.6252	0.6246
		h	Inside diameter of annular ball bearing	0.6247	0.6250	*
		g-h	Fit of annular ball bearing on governor control lever straight shaft	0.0001L	0.0005T	0.0004L
		j	Clearance between ball and socket (parallel to thread length)	0.0050L	0.0015L	0.0020L
		k	Manual fuel shutoff spring			
			Free length	2.750		
			Maximum load (pounds)	13.1		
			Rate (lbs/inch)	4.47		

Section XVII. REPAIR OF ENGINE AND TRANSMISSION OIL COOLERS AND ENGINE COOLING FAN

3-110. General

This section covers the repair of the engine and transmission oil coolers and cooling fan. Specific instructions on disassembly, cleaning, inspection, repair, and assembly accompany the repair operations. Stud identification information is included in the repair procedures where applicable.

3-111. Engine and Transmission Oil Cooler and Associated Parts

a. General. The engine oil coolers are identical and so are the transmission oil coolers. Adaptation to either right or left installation is accomplished by the addition of hose connections, elbows, and bypass valves. For instructional purposes, the engine and transmission oil coolers adapted for the left bank installation will be disassembled.

b. Disassembly.

(1) Remove the two engine oil cooler thermostatic valve assemblies (8, fig. 3-260). Remove and discard bypass valve spacer rings (7). Remove six self-locking nuts (18) and remove two

engine oil cooler elbows (17) and (22) from each engine cooler. Remove and discard gaskets (20).

(2) Remove six assembled washer bolts (3, fig. 3-261) and remove left and right bank timing access covers (8) from left and right bank oil cooler support frames (7 and 22).

(3) Remove two assembled washer bolts (3) and remove upper access cover (4) from left bank oil cooler support frame (22).

(4) Remove three assembled washer bolts (3) and remove upper access cover (19) from right oil cooler support frame (7).

c. Cleaning.

(1) Refer to paragraph 3-36. External surfaces of coolers may be cleaned using oil cooler cleaning tool Part No. 11641959. Clean throughly and blow dry with compressed air at 15 psi pressure.

(2) Flush oil cooler assemblies with dry-cleaning solvent (P-D-680, Type II). Blow dry with compressed air at a pressure of 15 psi.

d. Inspection. Refer to paragraph 3-37.

(1) *Oil Cooler Assemblies.* Inspect oil cooler assemblies for dented tubing or bent fins. Inspect gasket contact surfaces for burs and raised metal. Seal all oil cooler openings. Pressure check coolers by pumping engine oil (OE) into coolers at 400 psi hydrostatic pressure. Coolers must hold 400 psi for ten minutes without loss of pressure. Release pressure, drain oil, and flush with dry-cleaning solvent or mineral spirits paint thinner. Identify leaking coolers for possible repair.

(2) *Thermostatic bypass valves.* Inspect engine and transmission oil cooler thermostatic bypass valves for stripped or damaged threads. Check operation of valve assemblies by immersing valve in warm water. Check temperature of water with an accurate thermometer. Gradually raise temperature of water to temperature indicated on valve cover. Valves marked 148°F. must travel 1/4-inch between 90°F. and 150°F. Valves marked 185°F. must travel 1/4-inch between 110°F. and 185°F. Remove valve from water and clean with dry-cleaning solvent or mineral spirits paint thinner. Replace valve assembly when travel is less than 1/4 inch.

(3)*Oil cooler hoses.* Inspect oil cooler outlet and inlet hoses for breaks and abrasions in woven shielding. Test hoses at 400 psi. Replace hoses that do not pass pressure test.

(4)*Oil cooler screens.* Inspect oil cooler screens for bent, cracked or broken mounting brackets. Check for torn or broken screening. Replace screens that are unserviceable. Straighten bent screens to as near original shape as possible.

e. Repair. Refer to paragraph 3-38. Refer to paragraph 3-38*d* and table 3-29 when replacing studs.

NOTE

Do not repair leaks in oil coolers by soldering. Soldering is not an acceptable repair because of the high operating temperature and pressure.

Table 3-29. Engine Oil Cooler Standard Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-260	20	2	12	5/16-18 (13/16) x 5/16-24 (13/16) x 2-3/4

Refer to figure 3-141 oversize stud identification.

f. Assembly.

NOTE

The left bank lower engine oil cooler elbow (22, fig. 3-260) on Models AVDS-1790-2C and AVDS-1790-2D, is shorter than the upper engine oil cooler elbow (17). The left bank upper and lower engine oil cooler elbows (17) and (22) are the same length on Model AVDS-1790-2DR. The right bank upper and lower engine oil cooler elbows on all models are the same length as the left bank upper engine oil cooler elbow (17).

(1) Install two new gaskets (20, fig. 3-260), two engine oil cooler elbows (17) and (22) and secure with six self-locking nuts (18) on each cooler. Install new spacer rings (7) on transmission oil cooler thermostatic flow control valves (9). Install valve assemblies. Install new spacer rings (7) on two engine oil cooler thermostatic valve assemblies (8). Install valve assemblies.

(2) Install left timing access cover (8, fig. 3-261) on left oil cooler support frame (22) and secure with three assembled washer bolts (3). Install right access cover in the same manner.

(3) Install right bank upper access cover plate (19) on right oil cooler support frame (7) and secure with two assembled washer bolts (3).

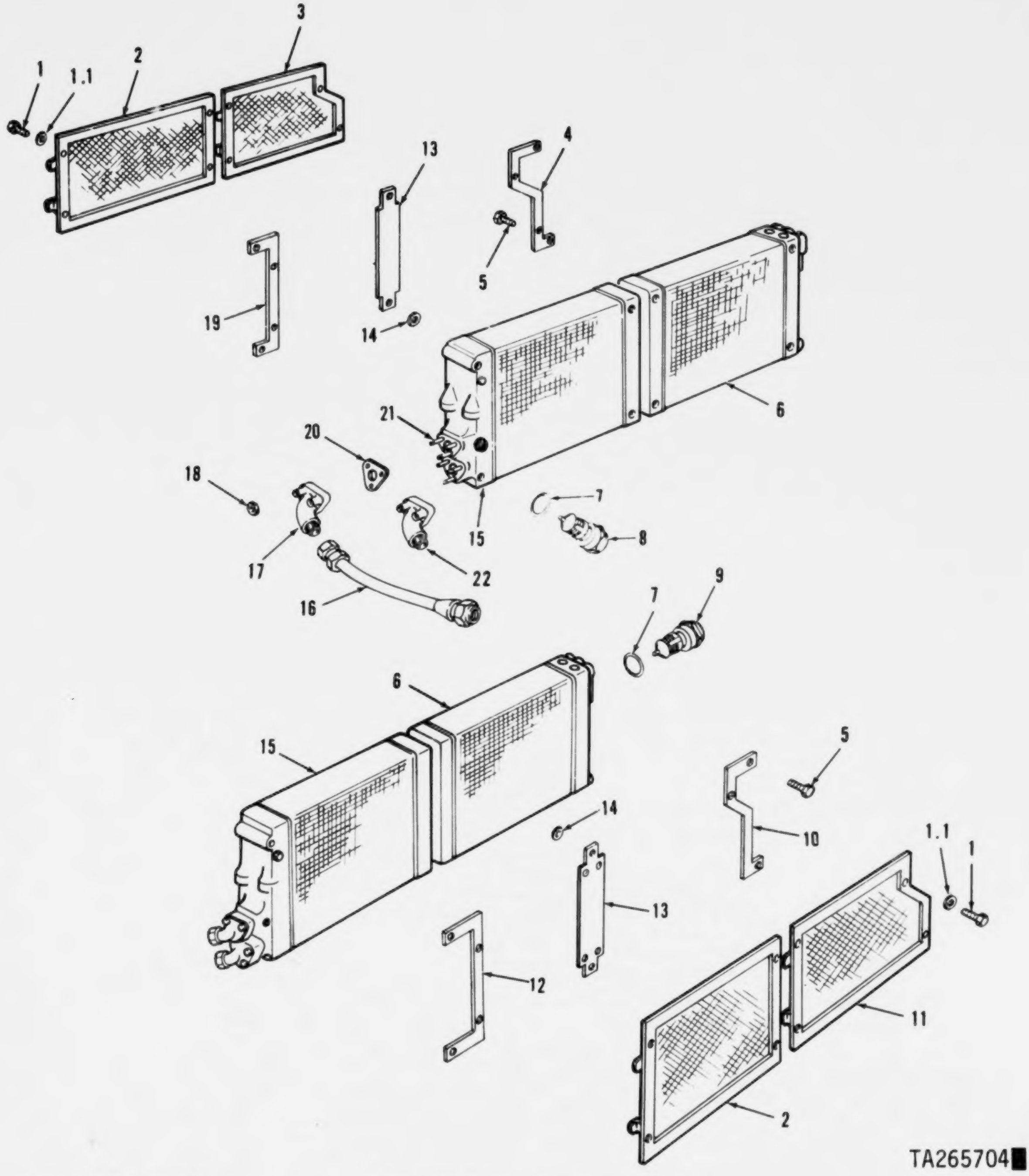
(4) Install left bank flywheel end upper access cover (4) on left bank oil cooler support frame (22) and secure with two assembled washer bolts (3).

3-112. Repair of Engine Cooling Fan and Associated Parts

a. Disassembly. Remove sixteen cotter pins (6, fig. 3-262), slotted nuts (18) flat washers (7) and machine bolts (8) attaching cooling fan hub to fan. Separate fan (16) from hub (17).

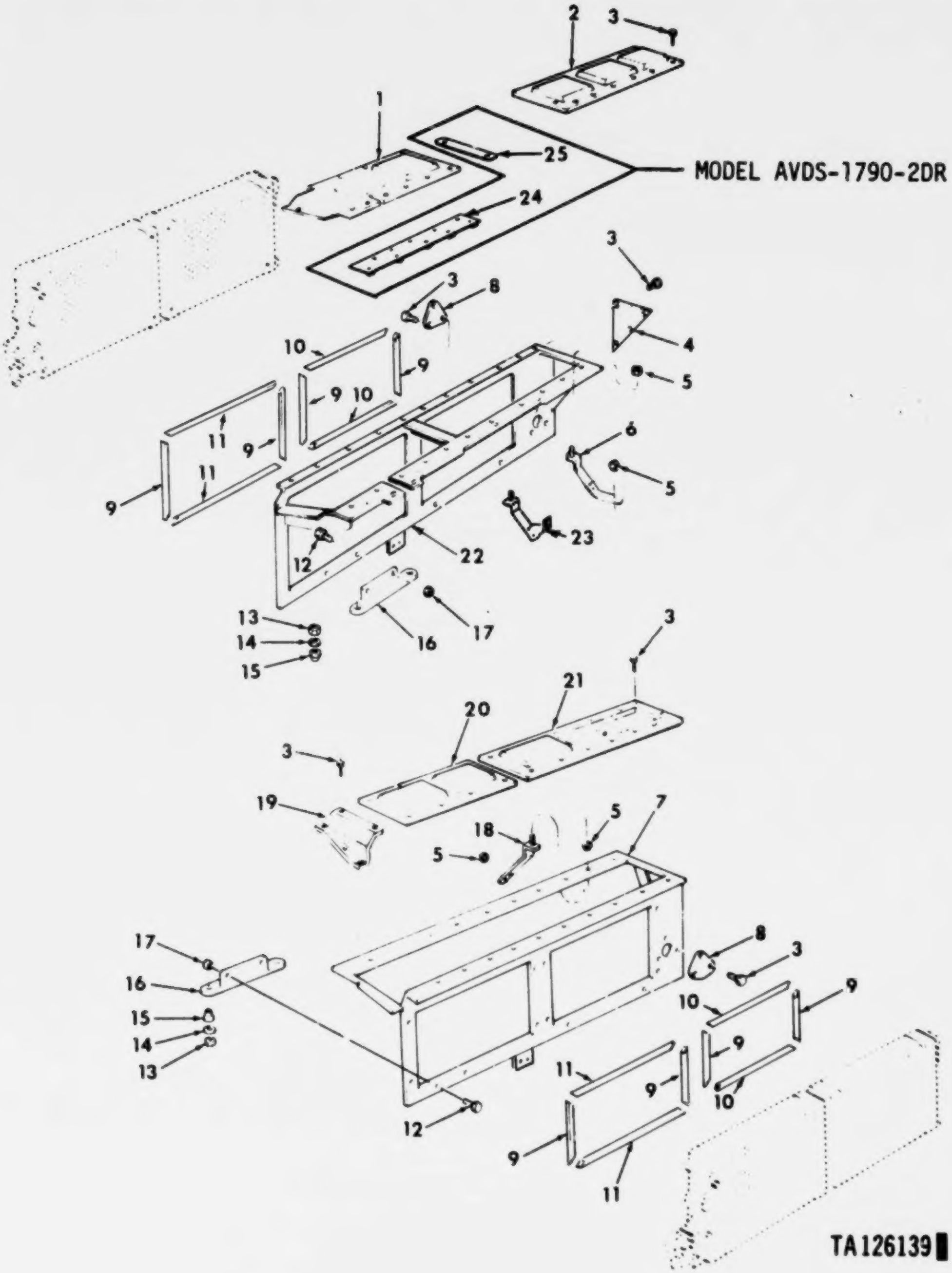
NOTE

The machined face of the fan is marked "TOP" to insure correct assembly.



1 Assembled washer bolt
1.1 Flat washer
2 Engine oil cooler screen
3 Transmission oil cooler screen
4 Transmission oil cooler screen bracket
5 Machine bolt
6 Transmission oil cooler
7 Bypass valve spacer ring
8 Oil cooler thermostatic valve assembly
9 Transmission oil cooler thermostat
10 Transmission oil cooler screen bracket
11 Transmission oil cooler screen
12 Oil cooler screen support bracket
13 Oil cooler screen center support bracket
14 Plain washer
15 Engine oil cooler
16 Engine oil cooler hose assembly
17 Engine oil cooler elbow
18 Self-locking nut
19 Oil cooler screen support bracket
20 Oil cooler connector gasket
21 Stud
22 Engine oil cooler elbow

Figure 3-260. Oil cooler, oil cooler screens and associated parts - exploded view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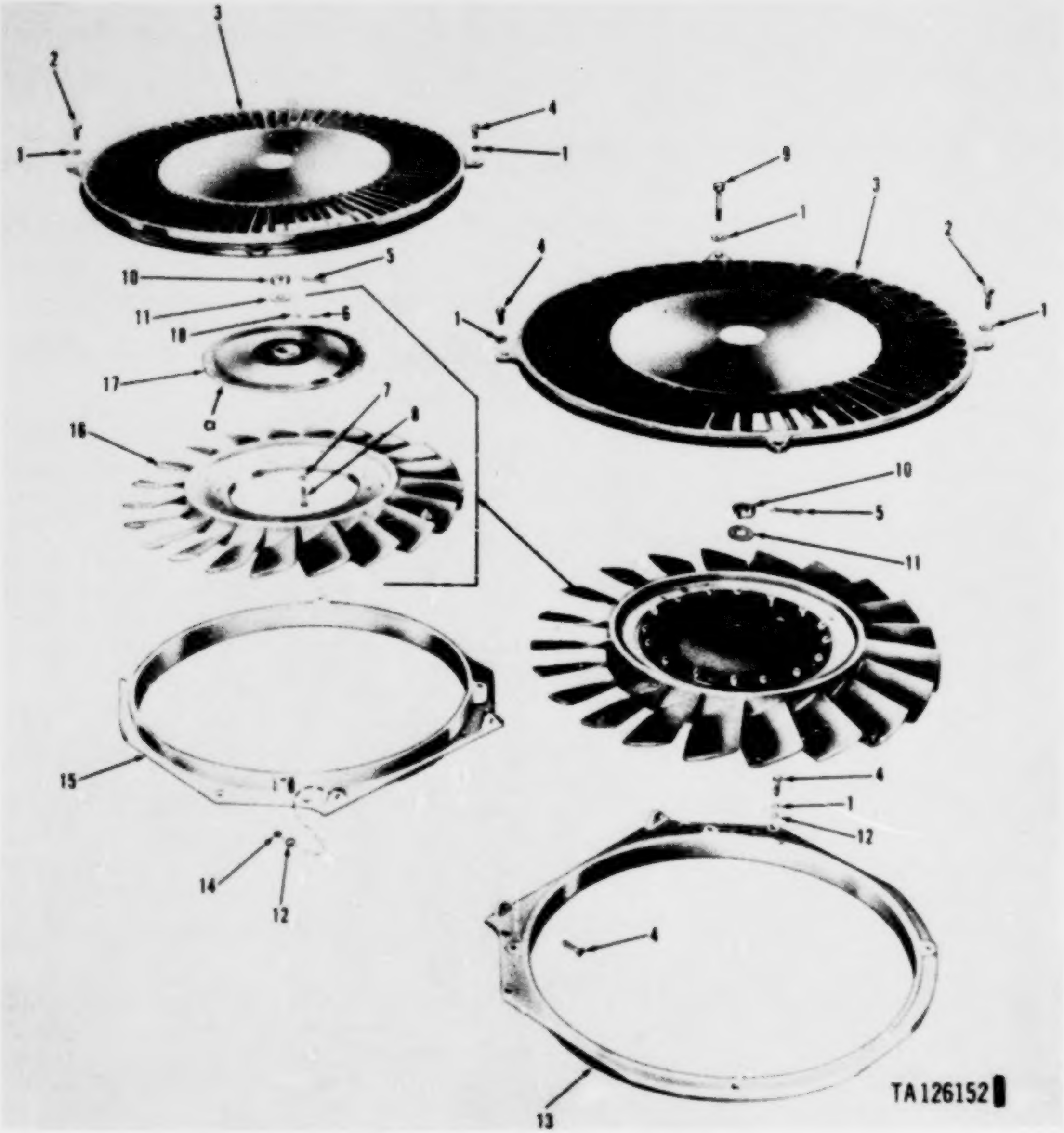
1 Left front upper cover
2 Left rear upper cover
3 Assembled bolt washer
4 Upper access cover
5 Self — locking nut
6 Oil cooler support frame bracket
7 Oil cooler support frame
8 Timing access cover
9 Oil cooler rubber strip
10 Oil cooler rubber strip
11 Oil cooler rubber strip
12 Hexagon head capscrew
13 Self — locking nut
14 Oil cooler frame spacer
15 Oil cooler frame rubber grommet
16 Oil cooler frame bracket
17 Self — locking nut
18 Oil cooler support frame bracket
19 Front upper access cover
20 Right front engine upper cover
21 Right rear engine upper cover
22 Oil cooler support frame
23 Oil cooler support frame bracket
24 Cover adapter
25 Retaining strap

Figure 3-261. Oil cooler frames and associated parts-exploded view.



1 Lockwasher
2 Machine bolt
3 Cooling fan vane housing
4 Hexagon capscrew
5 Cotter pin
6 Cotter pin
7 Flat washer
8 Machine bolt
9 Hexagon head capscrew
10 Slotted hexagon nut
11 Fan drive clutch thrust washer
12 Flat washer
13 Engine cooling fan housing
14 Self-locking nut
15 Engine cooling fan housing
16 Engine cooling fan
17 Engine cooling hub
18 Hexagon slotted plain nut

Figure 3-262. Engine cooling fans – exploded view.

b. Cleaning. Refer to paragraph 3-36.

c. Inspection. Inspect cooling fans using a magnifying glass (five power magnification minimum) under a strong light. Inspect for nicks, scratches and cracks. A radial crack in area of bolt hole is sufficient cause for replacement of fan. Discard cooling fans that have bent, broken or warped blades. Replace fan when bolt holes are elongated or show evidence of wear. Inspect fan blades for erosion. Place the Fan Rotor Gage, Part No. 12275775, on the top surface of any suspect blade with the tabs in contact with the trailing edge (fig. 3-262.1). If the blade is eroded to the extent that any part of the leading edge of the blade is hidden by the gage, the fan must be replaced.

d. Repair. Repair scratches, nicks, and raised metal using a fine mill file.

NOTE

> Care must be taken when using a file, not to remove excessive amounts of metal since this will disturb the delicate balance of the fan.

e. Assembly. Position cooling fan hub (17, 3-262) inside of fan (16) marked "TOP". Install sixteen machine bolts (8), flat washers (7), slotted nuts (18), and cotter pins (6) securing cooling fan hub to fan.

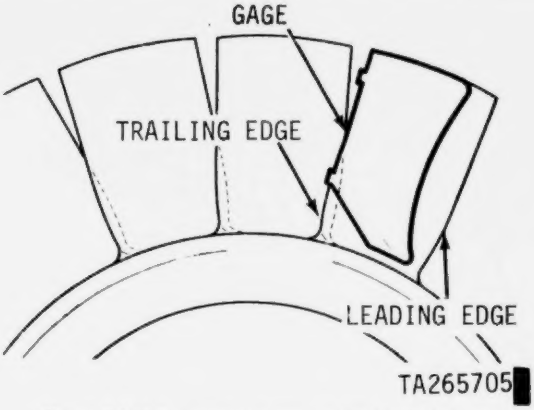


Figure 3-262.1. Inspecting cooling fan blades leading edge for erosion.

Section XVIII. REPAIR OF ENGINE SHROUDING AND ASSOCIATED PARTS

3-113. General

This section covers the repair of the engine shrouding and associated components. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operations.

NOTE

> Disassembly of various shroud components other than the cooling fan housing, shroud rails, and cover plates was accomplished during engine disassembly.

3-114. Disassembly

a. Remove ten bolts (4, fig. 3-263) and remove two access covers (5). Remove two capscrews (4, fig. 3-262), self-locking nuts (14) and flat washers (12) attaching engine cooling fan housing (15) to engine cooling fan housing (13). Remove eight capscrews (4), lockwashers (1) and flat washers (12) attaching damper end and flywheel end cooling fan housings to cooling fan engine shroud (1, fig. 3-263). Remove damper end and flywheel end cooling fan housings.

b. On Model AVDS-1790-2DR, remove five hexagon head capscrews (1, fig. 3-263.1) and lockwashers (2) and remove fan housing support assembly (3). Remove ten assembled washer bolts (4) and remove two access covers (5). Remove two capscrews (4, fig. 3-262), self-locking nuts (14) and flat washers (12) attaching engine cooling fan housing (15) to engine cooling fan housing (13). Remove eight capscrews (4), lockwashers (1) and flat washers (12) attaching damper end and flywheel end cooling fan housings to centrifugal fan housing (6, fig. 3-263.1). Remove damper end and flywheel end cooling fan housings.

3-115. Cleaning

Refer to paragraph 3-36.

3-116. Inspection and Repair

a. Refer to paragraph 3-37 and 3-38.

b. Inspect engine and transmission shroud and associated parts (fig. 3-263) and cylinder deflectors (fig. 3-264) and plates (fig. 3-265) for damaged, bent, or cracked condition. Straighten bent shrouds or plates as near original shape as possible. Replace cracked or badly broken shroud and plates.

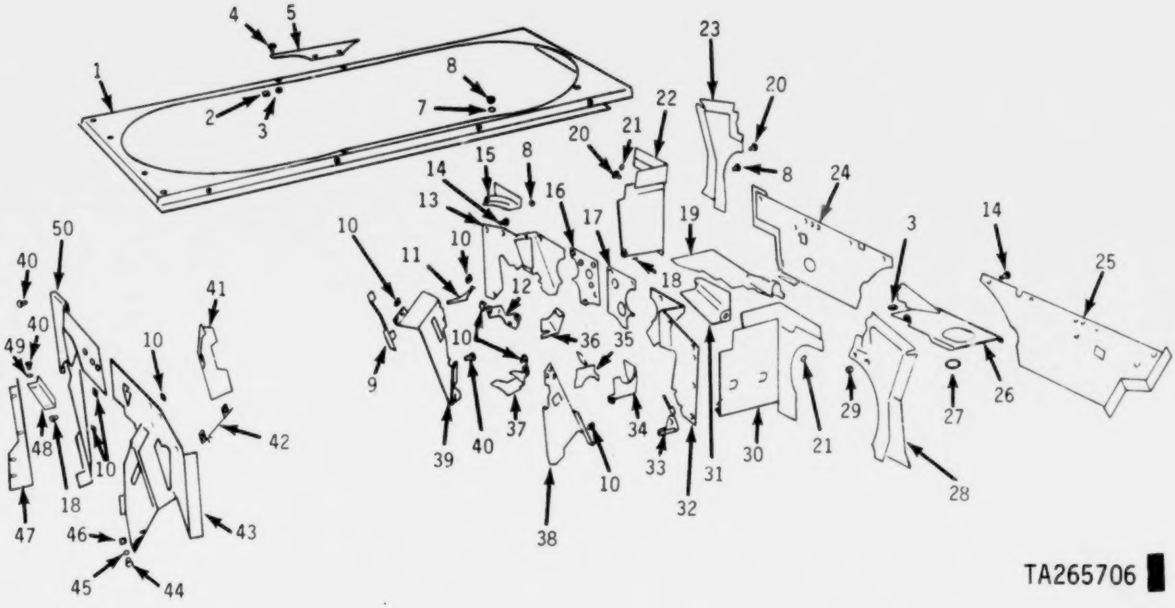
3-117. Assembly

a. Attach housing (13, fig. 3-262) to housing (15) with two capscrews (4) self-locking nuts (14) and flatwashers (12). Install engine cooling fan housings (13 and 15, fig. 3-262) on cooling fan engine shroud (1, fig. 3-263) and secure with eight capscrews (4, fig. 3-262) lockwashers (1), and flat washers (12).

a.1. Attach housing (13, fig. 3-262) to housing (15) with two capscrews (4), self-locking nuts (14) and flat washers (12). Install engine cooling fan housings (13 and 15, fig. 3-262) on centrifugal fan housing (6, fig. 3-263.1) and secure with eight capscrews (4, fig. 3-262), lockwashers (1), and flat washers (12).

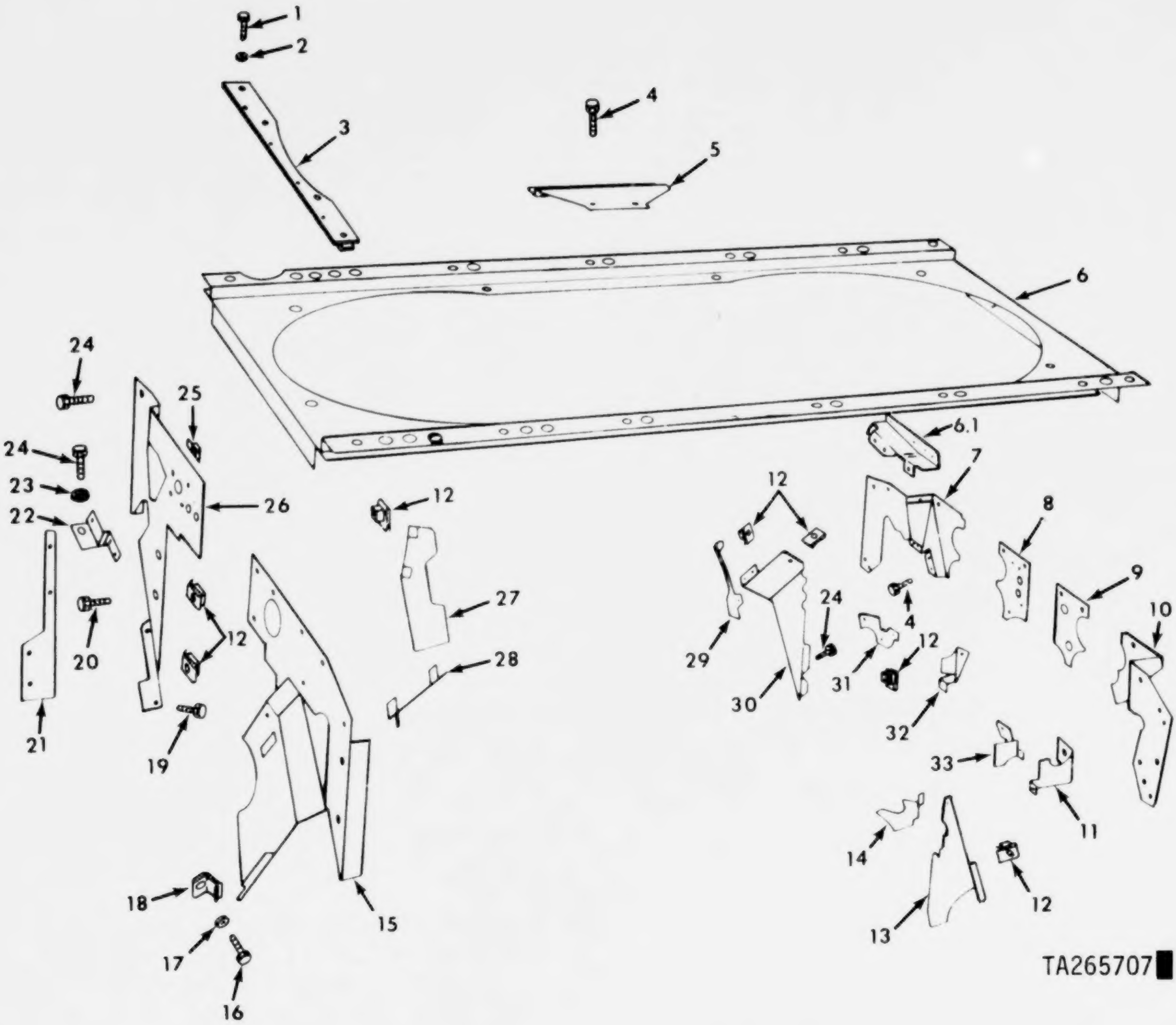
b. Install two cooling fan shroud access covers (5, fig. 3-263) on cooling fan engine shroud (1) and secure with six assembled washer bolts (4).

b.1. Install two access covers (5, fig. 3-263.1) and secure with 10 assembled washer bolts (4). Install fan housing support assembly (3) and secure with four hexagon head capscrews (1) and lockwashers (2).



1 Cooling fan engine shroud
2 Cooling fan engine shroud plain plate nut
3 Plain plate nut
4 Cooling fan shroud access cover assembled washer bolt
5 Cooling fan shroud access cover
6 Deleted
7 Flat washer
8 Self locking hexagon nut
9 Cooling shroud
10 Self-locking nut
11 Shroud plate
12 Left bank upper camshaft drive shroud
13 Left bank flywheel end upper engine shroud engine shroud
14 Assembled washer bolt
15 Left bank upper engine cooling shroud
16 Left bank exhaust manifold cooling shroud
17 Right bank exhaust manifold cooling shroud
18 Hexagon head capscrew
19 Left bank lower engine cooling shroud
20 Machine bolt
21 Rubber grommet
22 Left bank turbocharger inner shroud plate
23 Left bank outer turbocharger plate
24 Left bank lower intermediate shroud plate assembly
25 Right bank intermediate shroud plate
26 Right bank lower engine cooling shroud
27 Manifold air heater fuel return tube grommet
28 Right bank outer engine shroud plate
29 Plain plate nut
30 Right bank inner turbocharger shroud plate
31 Right bank upper transmission shroud
32 Right bank flywheel end upper engine shroud
33 Right bank flywheel end shroud plate
34 Right bank camshaft drive shaft lower engine cooling shroud
35 Right bank upper camshaft drive shroud
36 Left bank lower fan shaft shroud
37 Air flow baffle
38 Right bank flywheel end lower engine cooling shroud
39 Left bank flywheel end lower fan shroud
40 Machine screw
41 Air flow baffle
42 Cylinder shroud
43 Right bank damper end engine shroud
44 Hexagon head capscrew
45 Lockwasher
46 Engine shroud plate clip
47 Side engine shroud filler plate
48 Top engine shroud filler plate
49 Lockwasher
50 Left bank damper end engine shroud assembly

Figure 3-263. Engine shroud – exploded view, model AVDS-1790-2C and AVDS1790-2D engines.



1 Hexagon head capscrew
2 Lockwasher
3 Fan housing support assembly
4 Assembled washer bolt
5 Access cover
6 Centrifugal fan housing
6.1 Upper transmission shield
7 Diesel engine shroud plate
8 Manifold cooling shroud
9 Exhaust manifold shroud
10 Diesel engine shroud plate
11 Engine cooling shroud
12 Plate self-locking nut
13 Engine cooling shroud
14 Air flow baffle
15 Engine shroud
16 Hexagon head capscrew
17 Lockwasher
18 Clip
19 Assembled washer screw
20 Hexagon head capscrew
21 Engine shroud filler plate
22 Engine shroud filler plate
23 Lockwasher
24 Machine screw
25 Plate plain nut
26 Air flow baffle
27 Cylinder shroud
28 Cooling shroud
29 Diesel engine shroud plate
30 Air flow baffle
31 Camshaft drive shroud
32 Fan cooling shroud
33 Camshaft drive shroud

Figure 3-263.1. Engine shroud - exploded view, model AVDS-1790-2DR engine.

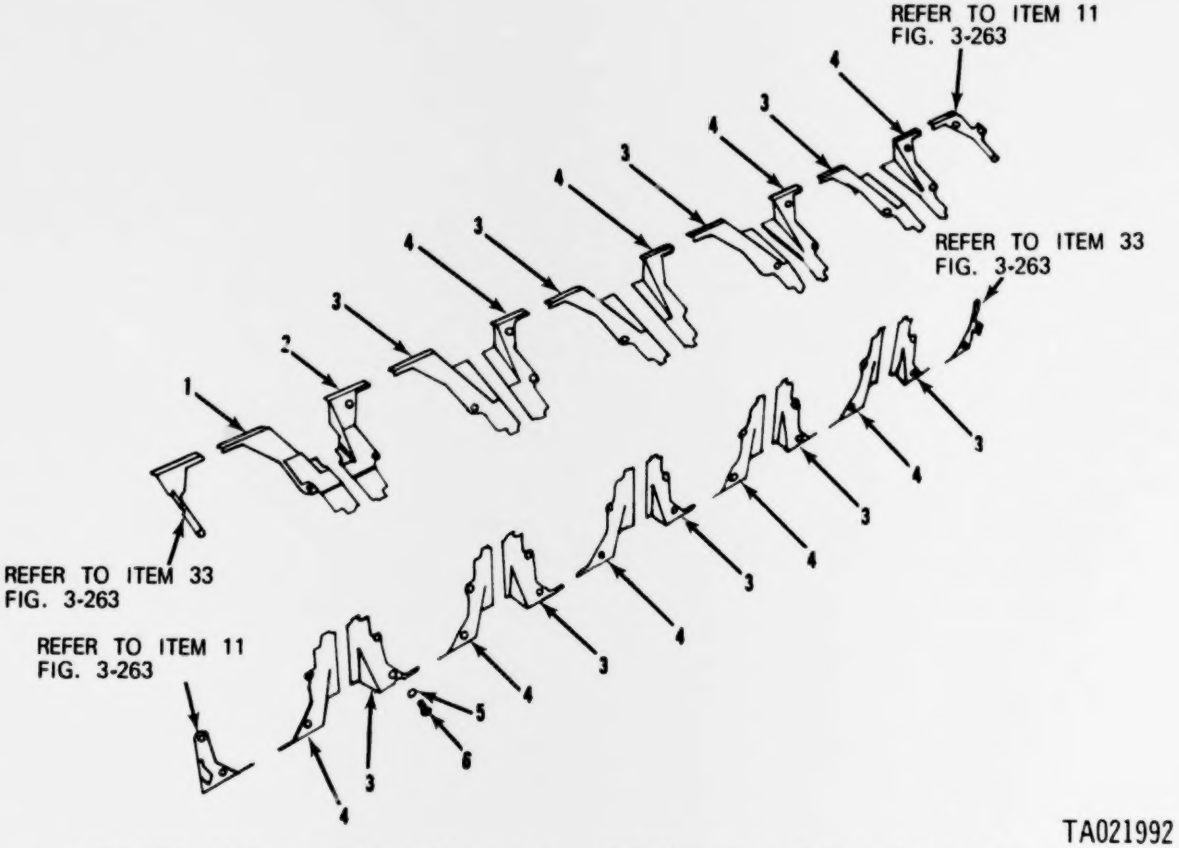

REFER TO ITEM 11
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FIG. 3-263
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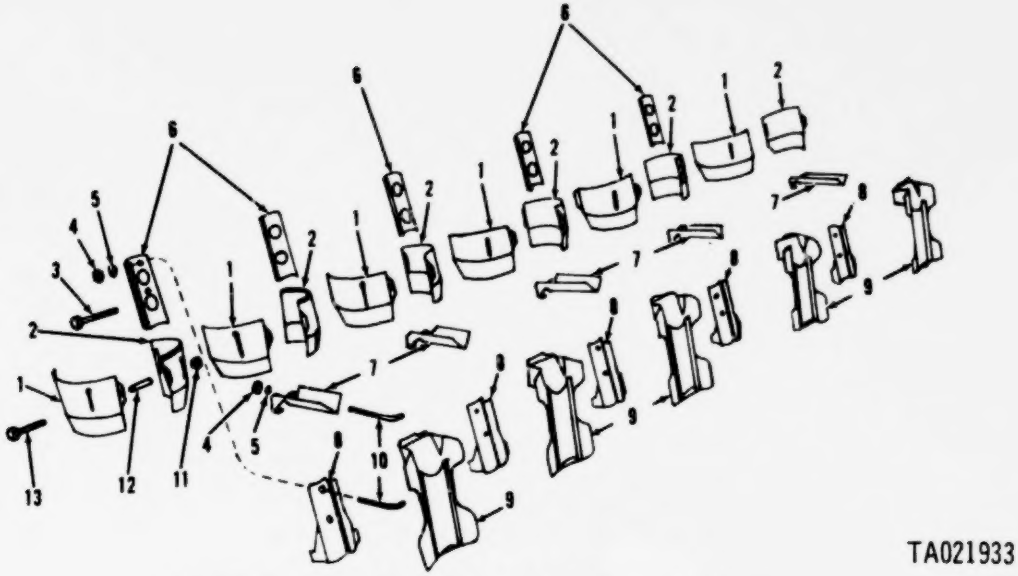
1 Right oil level indicator cylinder head shroud plate
2 Left oil level indicator cylinder head shroud plate.
3 Right intermediate cylinder head shroud plate
4 Left intermediate cylinder head shroud piate
5 Lockwasher
6 Capscrew

Figure 3-264. Cylinder deflectors – exploded view.



1 Left engine cooling air deflector
2 Right engine cooling air deflector
3 Machine bolt
4 Hexagon self-locking nut
5 Flat washer
6 Cylinder air deflector outer retaining strap
7 Intercylinder engine cooling air deflector
8 Inner cylinder air deflector retaining strap
9 Intercylinder engine cooling air deflector
10 Cylinder air deflector hook bolt
11 Hexagon self-locking nut
12 Cylinder air deflector sleeve spacer
13 Hexagon head capscrew

Figure 3-265. Cylinder plates – exploded view.

Section XIX. REPAIR OF INTAKE MANIFOLDS AND FLAME HEATER ASSEMBLY

3-118. General

This section covers the repair of the intake manifolds and flame heater assembly. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operations. Stud identification information is included in the repair procedures where applicable.

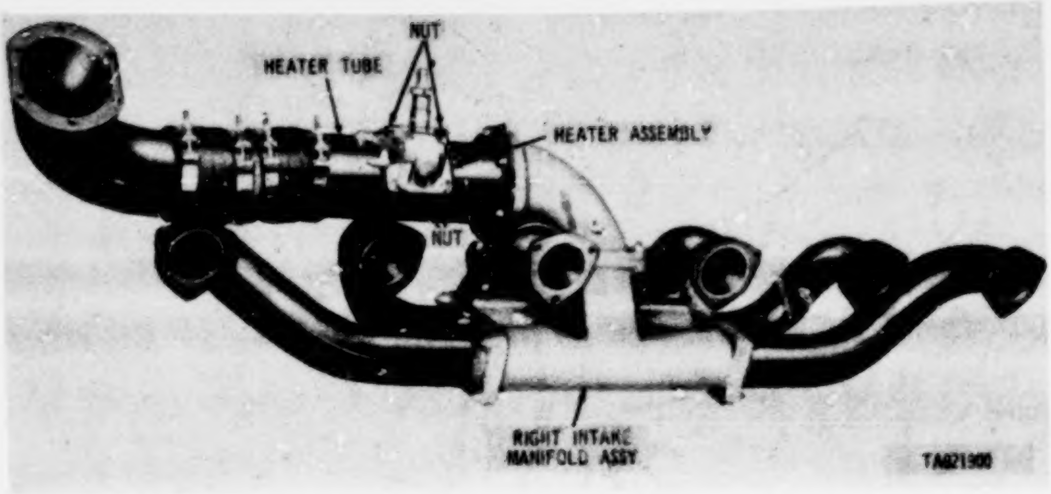
3-119. Disassembly

NOTE

The right and left intake manifolds are similar and are disassembled in the same manner. For instructional purposes the right intake manifold will be disassembled. The left intake manifold is mentioned only when there is a difference in disassembly procedures. Right bank manifold elbow assembly contains alternator air vent elbow fitting.

a. Remove four self-locking nuts and flat washers (fig. 3-266) attaching right manifold heater assembly to right heater tube. Remove manifold heater assembly and remove and discard heater gasket (20, fig. 3-267).

b. Remove the manifold heater spark plug (18.1, fig. 3-267) and remove and discard gasket (19). Remove fuel outlet elbow (37) from nozzle assembly (17). Remove fuel inlet elbow (13), bushing (14), and loosen jam nut and remove fuel nozzle assembly (17).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HEATER TUBE
HEATER ASSEMBLY
NUT
RIGHT INTAKE MANIFOLD ASSY
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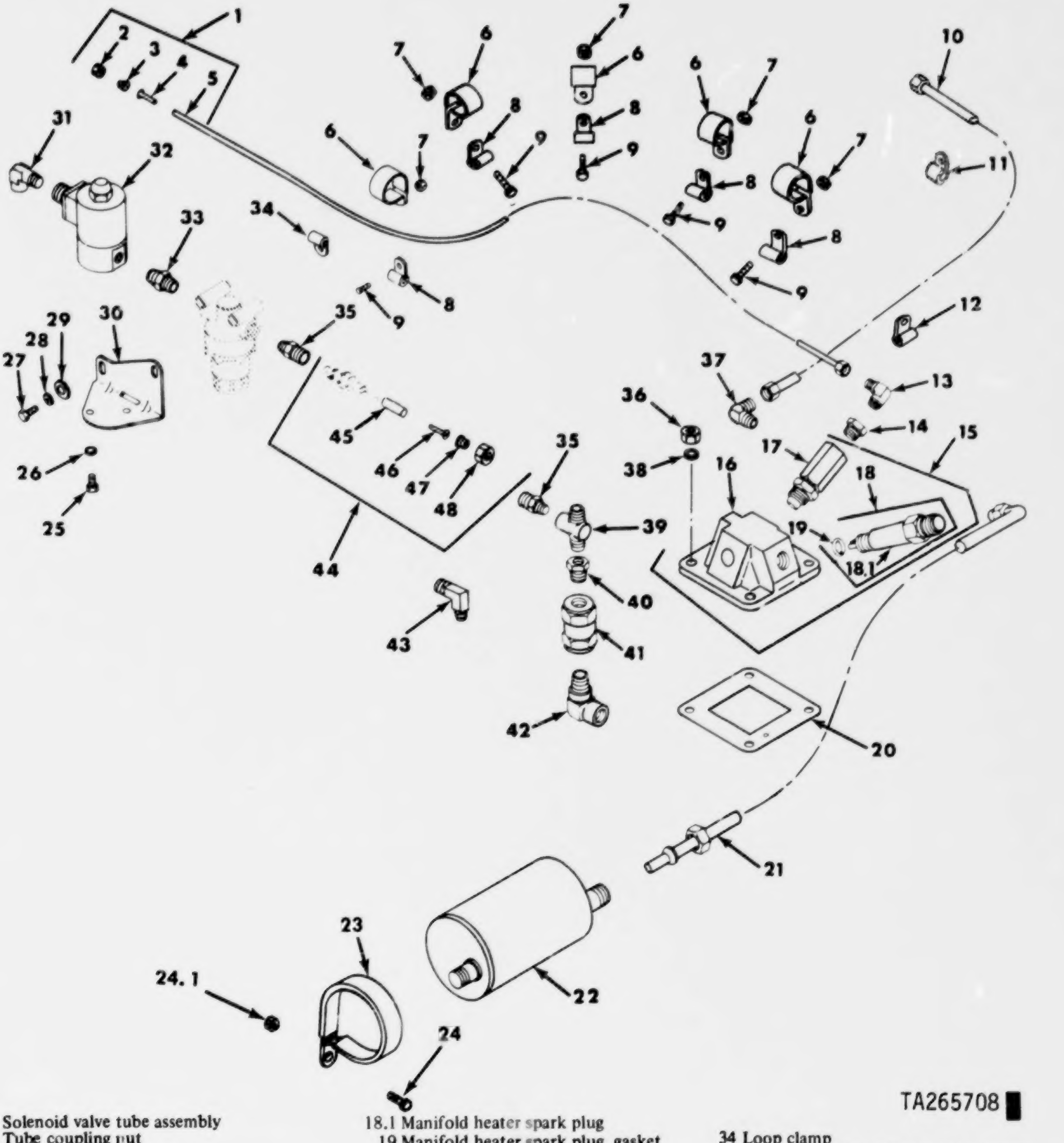
Figure 3-266. Removing or installing manifold heater assembly.



1 Solenoid valve tube assembly
2 Tube coupling nut
3 Sleeve
4 Insert
5 Tube
6 Loop clamp
7 Hexagon self-locking nut
8 Loop clamp
9 Machine screw
10 Manifold air heater fuel return tube assembly
11 Loop clamp
12 Loop clamp
13 Manifold air heater fuel inlet elbow
14 Manifold air heater fuel inlet bushing
15 Manifold air heater assembly
16 Manifold air heater
17 Manifold air heater fuel nozzle assembly
18 Manifold air heater spark plug assembly
18.1 Manifold heater spark plug
19 Manifold heater spark plug gasket
20 Manifold air heater gasket
21 Heater electrical lead
22 Ignition unit
23 Ignition unit loop clamp
24 Hexagon head capscrew
24.1 Self-locking nut
25 Assembled washer bolt
26 Flat washer
27 Assembled washer bolt
28 Lockwasher
29 Flat washer
30 Solenoid valve bracket
31 Elbow
32 Solenoid valve
33 Nipple
34 Loop clamp
35 Manifold heater fuel inlet tube adapter
36 Hexagon self-locking nut
37 Manifold air heater fuel outlet elbow
38 Intake manifold heater flat washer
39 Check valve inlet tee
40 Purge pump inlet tee reducer
41 Main fuel supply filter (Models AVDS-1790-2C and AVDS-1790-2D only)
42 Fuel filter elbow (Model AVDS-1790-2C only)
43 Elbow (Model AVDS-1790-2DR)
44 Manifold heater fuel inlet tube assembly
45 Tube
46 Insert
47 Sleeve
48 Tube coupling nut

Figure 3-267. Manifold heater system, right bank—exploded view.

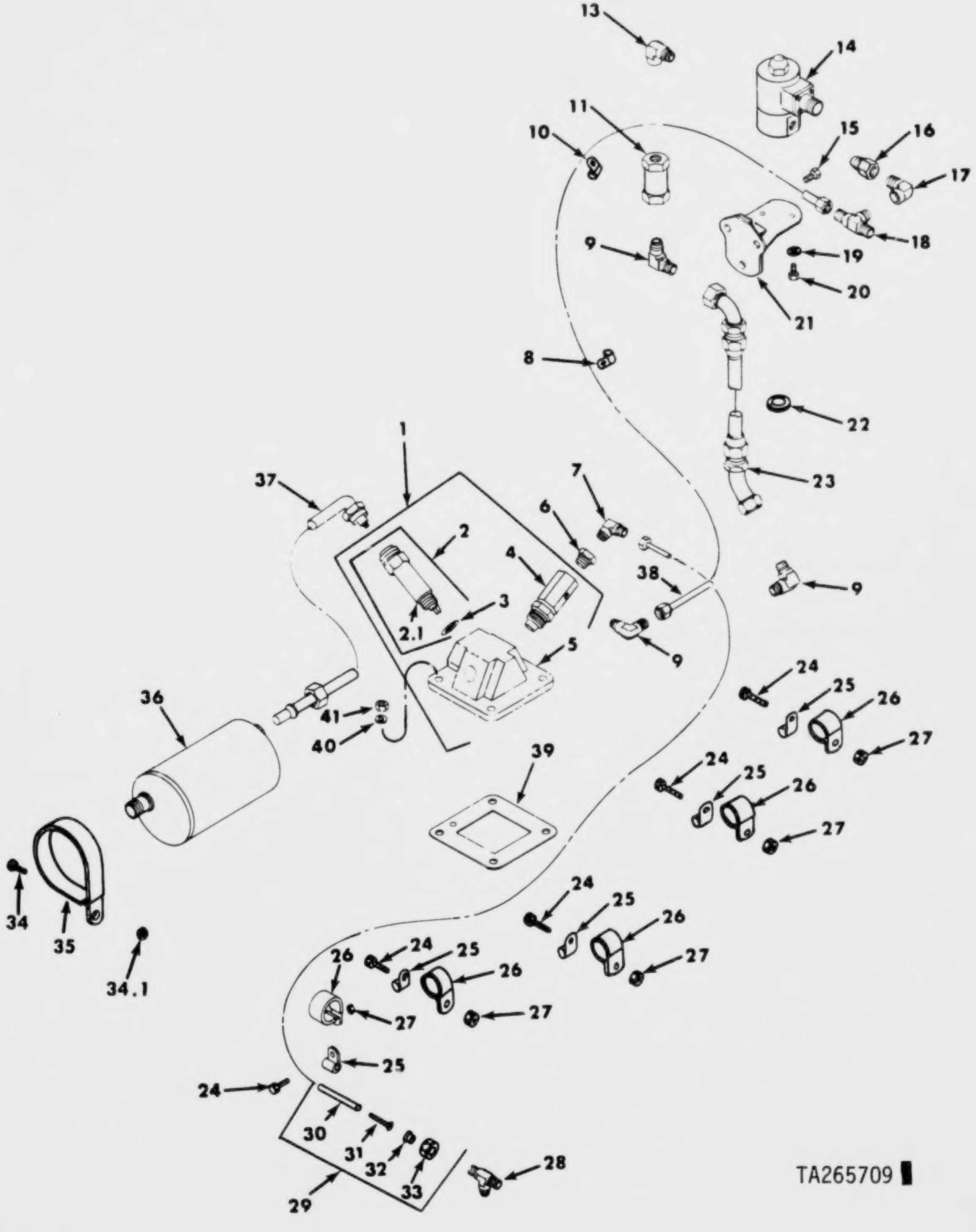

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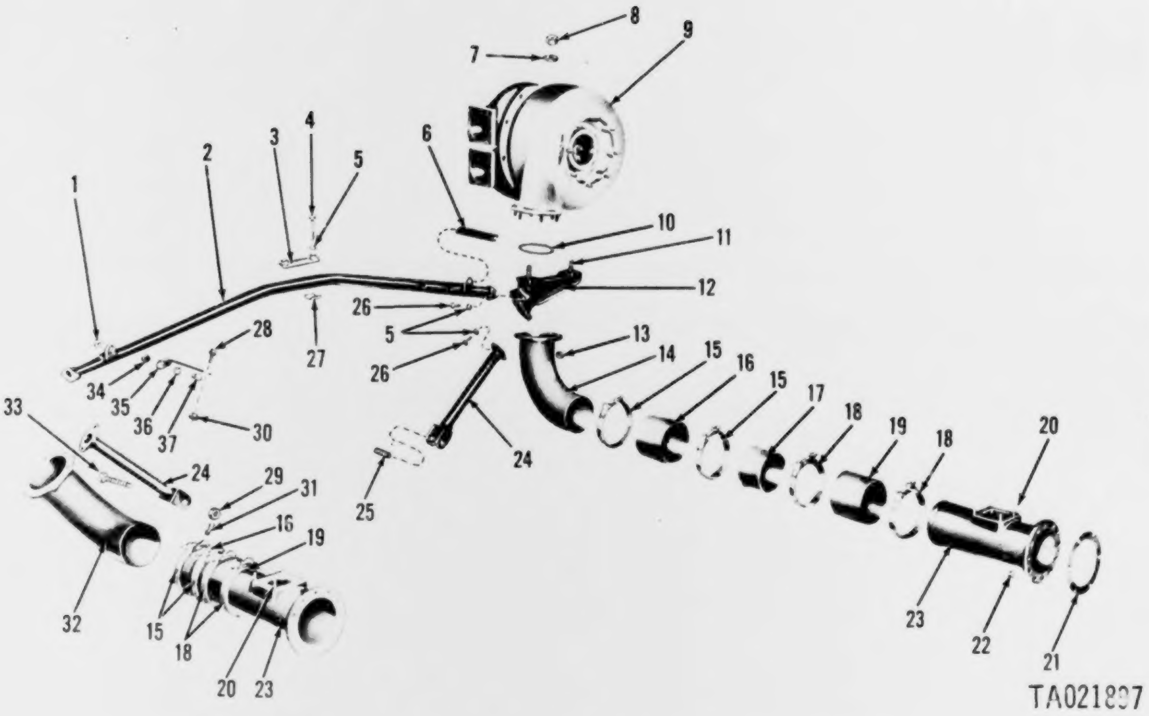
Figure 3-268. Manifold heater system, left bank–exploded view.

c. Loosen two right turbosupercharger outlet elbow hose clamps (15, fig. 3-269) and remove right turbosupercharger air outlet elbow (14) from air outlet elbow hose (16). Remove hose and two clamps and separate clamps from hose.

Legend for Figure ***3-268.***

1 Manifold heater assembly
2 Manifold air heater spark plug assembly
2.1 Manifold heater spark plug
3 Manifold heater spark plug gasket
4 Manifold air heater fuel nozzle assembly
5 Manifold air heater
6 Manifold air heater fuel inlet bushing
7 Manifold air heater fuel inlet elbow
8 Loop clamp
9 Elbow
10 Loop clamp
11 Check valve
12 Deleted
13 Elbow
14 Solenoid valve
15 Machine bolt
16 Coupling
17 Elbow
18 Tee
19 Flat washer
20 Assembled washer bolt
21 Solenoid valve bracket
22 Rubber grommet
23 Solenoid valve outlet tube assembly
24 Machine screw
25 Loop clamp
26 Loop clamp
27 Hexagon self-locking nut
28 Tee
29 Left bank solenoid valve tube assembly
30 Tube
31 Insert
32 Sleeve
33 Tube coupling nut
34 Hexagon head capscrew
34.1 Self-locking nut
35 Ignition unit loop clamp
36 Ignition unit
37 Heater electrical lead
38 Manifold air heater fuel return tube assembly
39 Manifold air heater gasket
40 Intake manifold heater flat washer
41 Hexagon self-locking nut



1 Self-locking nut
2 Turbosupercharger tie rod
3 Turbosupercharger tie rod clamp
4 Hex head capscrew
5 Lockwasher
6 Right bank turbosupercharger support bracket
7 Flat washer
8 Self-locking nut
9 Turbosupercharger assembly
10 Turbosupercharger outlet elbow gasket
11 Turbosupercharger mounting stud
12 Turbosupercharger base assembly
13 Self-locking nut
14 Right turbosupercharger air outlet elbow
15 Turbosupercharger outlet elbow hose clamp
16 Turbosupercharger outlet elbow hose
17 Tube
18 Intake manifold tube hose clamp
19 Intake manifold tube hose
20 Manifold heater stud
21 Intake manifold tube gasket
22 Hexagon self-locking nut
23 Intake manifold tube
24 Turbosupercharger support assembly
25 Resilient mount
26 Hexagon head capscrew
27 Tie rod seat clamp
28 Hexagon head capscrew
29 Plain slotted hexagon nut
30 Self-locking hexagon nut
31 Cotter pin
32 Left turbosupercharger outlet elbow
33 Close tolerance bolt
34 Rubber grommet
35 Left bank turbosupercharger support bracket
36 Retainer
37 Hexagon capscrew

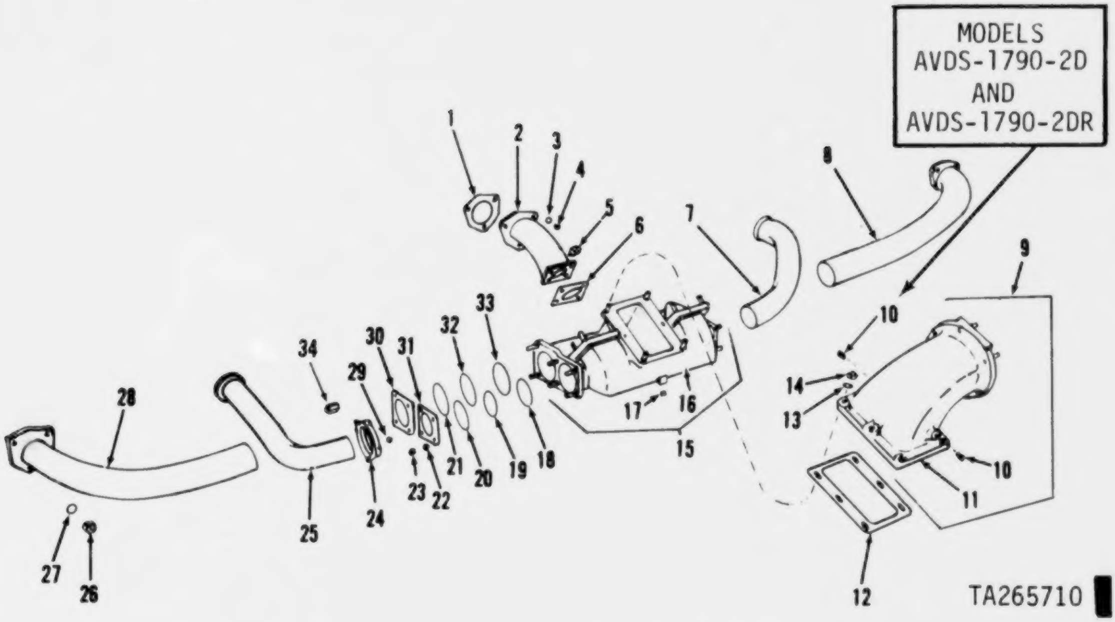
Figure 3-269. Turbosupercharger, tie rod, support and associated parts.

d. Loosen two right intake manifold tube hose clamps (18) and remove intake manifold tube (17) from intake manifold tube hose (19). Remove hose and two clamps and separate clamps from hose.

NOTE

Scribe a line across flange of intake manifold tube (23) and intake manifold elbow (11, fig. 3-270) for correct positioning during assembly.

e. Remove six self-locking nuts (22, fig. 3-269) and remove intake manifold tube (23) from manifold elbow assembly (9, fig. 3-270) and discard gasket (21, fig. 3-269).



1 Gasket
2 No. 3 and 4 right bank intake manifold tube assembly
3 Lockwasher
4 Plain hexagon nut
5 Self-locking hexagon nut
6 No. 3 and 4 right intake manifold tube gasket
7 No. 5 right intake manifold tube assembly
8 No. 6 right intake manifold tube assembly
9 Intake manifold elbow assembly
10 Pipe plug
11 Intake manifold elbow
12 Intake manifold elbow gasket
13 Flat washer
14 Self-locking nut
15 Intake air manifold assembly
16 Intake air manifold
17 Pipe plug
18 No. 2 right intake manifold preformed packing
19 Small flat washer
20 Intake manifold small spring tension washer
21 Intake manifold large spring tension washer
22 Flat washer
23 Self-locking nut
24 Intake manifold pipe flange
25 No. 2 right intake manifold tube assembly
26 Plain hexagon nut
27 Lockwasher
28 No. 1 right intake manifold tube assembly
29 Self-locking nut
30 Large pipe flange
31 Small pipe flange
32 Large flat washer
33 No. 1 right intake manifold preformed packing
34 Spacer and lockwasher

Figure 3-270. Intake manifold, tubes and associated parts.

f. Remove spacer and lockwasher (34, fig. 3-270), three self-locking nuts (29) and two self-locking nuts (23) and flat washers (22) attaching small (31) and larger (30) intake manifold pipe flanges to intake air manifold assembly (15). Separate No. 2 right (25) and N0. 1 right (28) intake manifold tubes from manifold assembly. Separate No. 6 right (8) and No. 5 right (7) tub in the same manner.

g. Remove and discard preformed packing (18). Remove small flat washer (19) and small spring tension washer (20) and small pipe flange (31) from No. 2 right intake manifold tube (25).

h. Remove and discard preformed packing (33). Remove large flat washer (32) and large spring tension washer (21) and large pipe flange (30) from No. 1 right intake manifold tube (28). Remove pipe flanges (24) from No. 2 right (25) and No. 1 right (28), tubes.

i. Remove flanges and associated parts from No. 6 right (8) and No. 5 right (7) intake manifold tubes in the same manner.

j. Remove eight self-locking nuts (5) attaching No. 3 and No. 4 right intake manifold tube assembly (2) to intake manifold (15). Remove tubes and remove and discard two intake manifold tube gaskets (6).

NOTE

The right and left intake manifold elbows (15) are identical. The position of the left intake manifold elbow is 180 degrees opposite from the position of the right elbow.

k. Remove six self-locking nuts (14) and flat washers (13) attaching right intake manifold elbow (9) to right intake manifold. Remove elbow from manifold and remove and discard elbow gasket (12).

3-120. Cleaning

Refer to paragraph 3-36. Clean intake manifold rubber hose using a dry cloth only.

3-121. Inspection and Repair

a. General. Refer to paragraphs 3-37 and 3-38.

b. Manifold Heater Assembly. Inspect manifold air heater fuel nozzle assembly (16, fig. 3-267) for damaged threads.

c. Spark Plugs. Refer to appropriate manual for care and maintenance of spark plug. Set plug gap from 0.094 to 0.114 inches.

d. Studs. Refer to paragraph 3-38, table 3-30, and figure 3-261 when replacing studs.

Table 3-30. Manifold Heater Induction and Intake Manifold Standard Stud Identification

Fig. No.	Ref. No.	Setting height	No. req'd	Stud size and length
3-269	11	1-3/8	4	1/2-20 (7/8) x 1/2-20 (15/16) x 2-1/8
3-269	20	13/16	8	5/16-24 (25/32) x 5/16-24 (19/32) x 1-7/16
3-271	4	13/16	16	5/16-18 (9/16) x 5/16-24 (11/16) x 1-3/8
3-271	1,5	1	12	5/16-18 (3/4) x 5/16-24 (23/32) x 1-5/8
3-271	2	25/32	12	5/16-18 (11/16) x 5/16-24 (9/16) x 1-5/16
	3	23/32	24	5/16-18 (11/16) x 5/16-24 (9/16) x 1-5/16

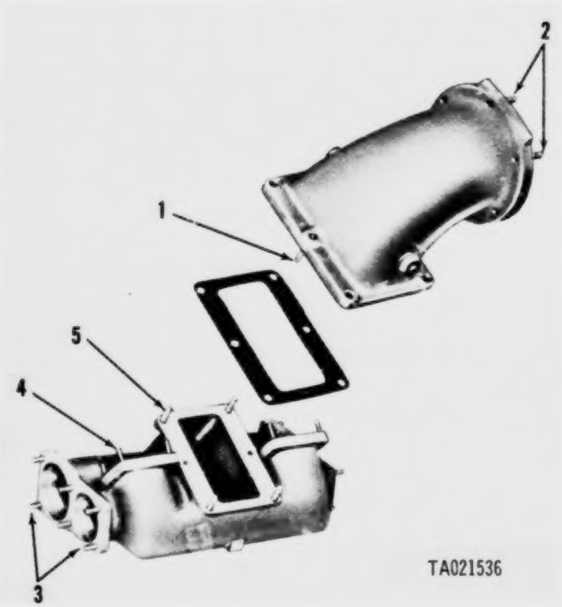


Figure 3-271. Right and left intake manifold stud identification.

3-122. Assembly

a. Using new intake manifold elbow gasket (12, fig. 3-270) install right intake manifold elbow (9) with generator vent elbow adapter (2, fig. 3-287) installed on right intake manifold assembly (15, fig. 3-270) (AVDS-1790-2C only) and secure with six self-locking nuts (14) and flat washers (13).

b. **Using new No. 3 right and 4 right intake manifold tube gaskets (6) install No. 3 right and 4 right intake manifolds (2) on right intake manifold assembly (15) and secure with eight self-locking nuts (5).**

c. Install pipe flanges (24) on No. 2 right (25) and No. 1 right (28) intake manifold tubes. Install large pipe flange (30), large spring tension washer (21) large flat washer (32) and a new preformed packing (33) on No. 1 right intake manifold tube (28).

d. Install small pipe flange (31), small spring tension washer (20), small flat washer (19) and a new preformed packing (18) on No. 2 right intake manifold tube (25).

e. Install flanges and associated parts on No. 6 right (8) and No. 5 right (7) intake manifold tubes in the same manner.

f. Install assembled No. 2 right and No. 1 right intake manifold tubes in right intake manifold tube assembly (15) and loosely install with two self-locking nuts (23) and flat washers (22), one spacer and lockwasher (34) and three self-locking nuts (29). Install assembled No. 6 right and No. 5 right intake manifold tubes in the same manner, using four self-locking nuts (29).

g. Using a new intake manifold tube gasket (21, fig. 3-269) and with scribe marks alined, install intake manifold tube (23) on intake manifold elbow assembly (9, fig. 3-270) and secure with six self-locking nuts (22, fig. 3-269).

h. Install two intake manifold tube hose clamps (18, fig. 3-269) loosely on the intake manifold tube hose (19). Install two turbosupercharger outlet elbow hose clamps (15) loosely on turbosupercharger outlet hose (16). Install both hose assemblies on air outlet tube (17). Butt the hoses together at the alignment mark on the air outlet tube (fig. 3-271.1).

i. Install assembled tube and hoses on intake manifold (23, fig. 3-269). Install right turbosupercharger air outlet elbow (14) in tube. Position hoses evenly between alinement marks on the air outlet elbow (14) and the intake manifold tube (23). Position hose clamps (15 and 18) 1/8 inch from the ends of the hoses and torque tighten (dry) to 30 - 40 pound inches.

j. Install fuel nozzle assembly (17, fig. 3-267), bushing (14) and fuel inlet elbow (13) in right manifold air heater (16). Aline nozzle fittings and tighten nozzle jam nuts. Install fuel outlet elbow (37) in nozzle assembly (17). Using a new gasket (19) install spark plug (18.1) in heater assembly (16).

_k_. Using a new intake manifold air heater gasket (44) install right manifold heater assembly (fig. 3-266) and fittings on heater tube and secure with four self-locking nuts and flat washers.

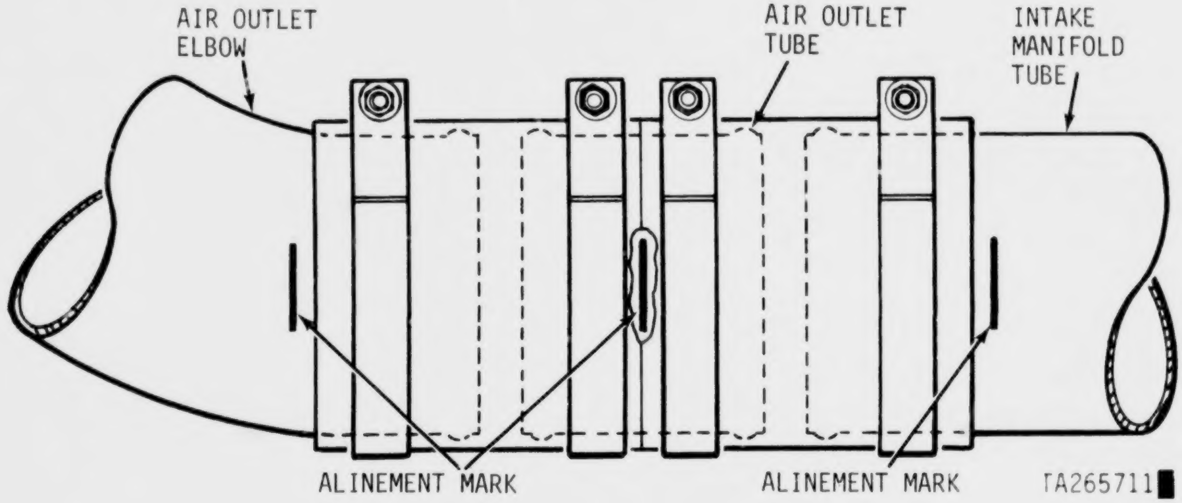


Figure 3-271.1. Alinement of Intake manifold tubes and hoses.

Section XX. REPAIR OF EXHAUST MANIFOLDS, CYLINDER HEAD OIL DRAIN TUBES, AND OIL FILLER AND OIL LEVEL INDICATOR TUBES

3-123. General

This section covers the repair of the exhaust manifolds and tubes, cylinder head oil drain tubes and oil filter and oil level indicator tubes. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operations.

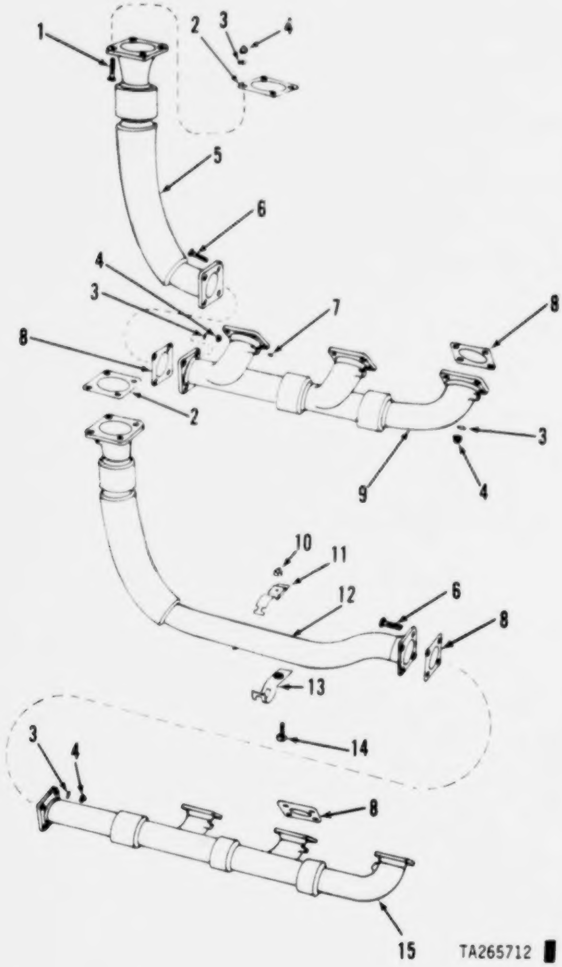


Figure 3-272. Exhaust manifold associated parts (right bank) - exploded view.

LEGEND for fig. 3-272 continued:

1 Capscrew
2 Gasket
3 Flat washer
4 Self-locking nut
5 No. 4, 5, and 6 right bank exhaust pipe
6 Capscrew
7 Pipe plug
8 Gasket
9 No. 4, 5, and 6 right bank engine exhaust manifold
10 Self-locking nut
11 Retaining strap
12 No. 1, 2, and 3 right bank exhaust pipe
13 Retaining strap
14 Machine bolt
15 No. 1, 2, and 3 right bank engine exhaust manifold

3-124. Disassembly

a. Exhaust Manifolds. Exhaust manifolds were disassembled during engine disassembly.

b. Cylinder Head Oil Drain Tubes. Loosen all hose clamps (1, fig. 3-274). Separate and remove right rear cylinder head oil drain tube (21) and turbosupercharger oil drain tube (22). Separate and remove right bank oil pan inlet drain tube (7), right front cylinder head oil drain tube (6), right front oil drain manifold tube assembly (5), four intermediate cylinder head oil drain tubes (3), rear cylinder head oil drain tube (2) and clamps. Disassemble left bank drain tubes in the same manner.

LEGEND for fig. 3-273 continued:

1 Gasket
2 No. 4, 5, and 6 left bank engine exhaust manifold
3 Flat washer
4 Self-locking nut
5 Pipe plug
6 Gasket
7 Capscrew
8 No. 4, 5, and 6 left bank exhaust pipe
9 Capscrew
10 Machine bolt
11 Exhaust manifold elbow retaining strap
12 No. 1, 2, and 3 left bank exhaust pipe
13 Retaining strap
14 Self-locking nut
15 No. 1, 2, and 3 left bank engine exhaust manifold

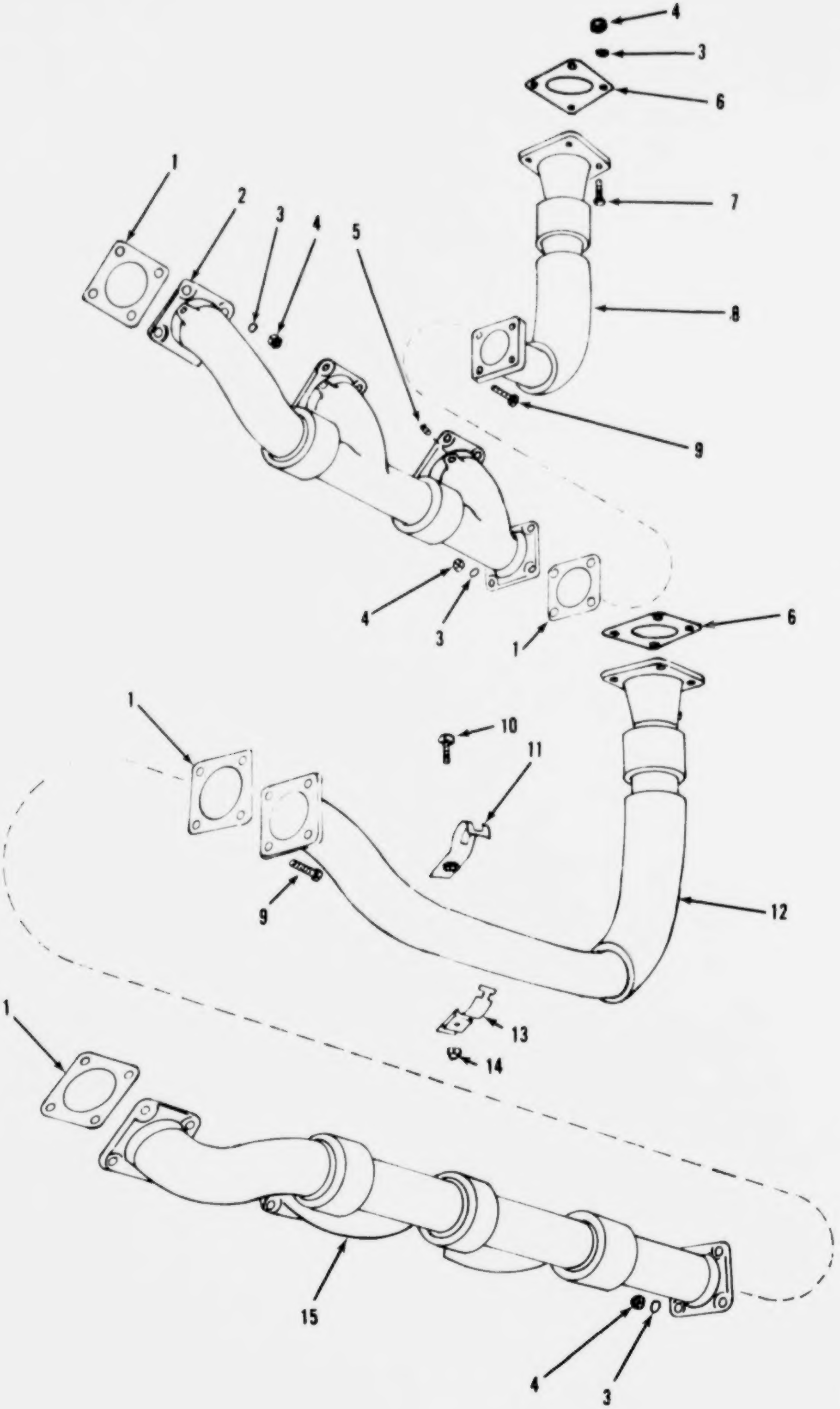

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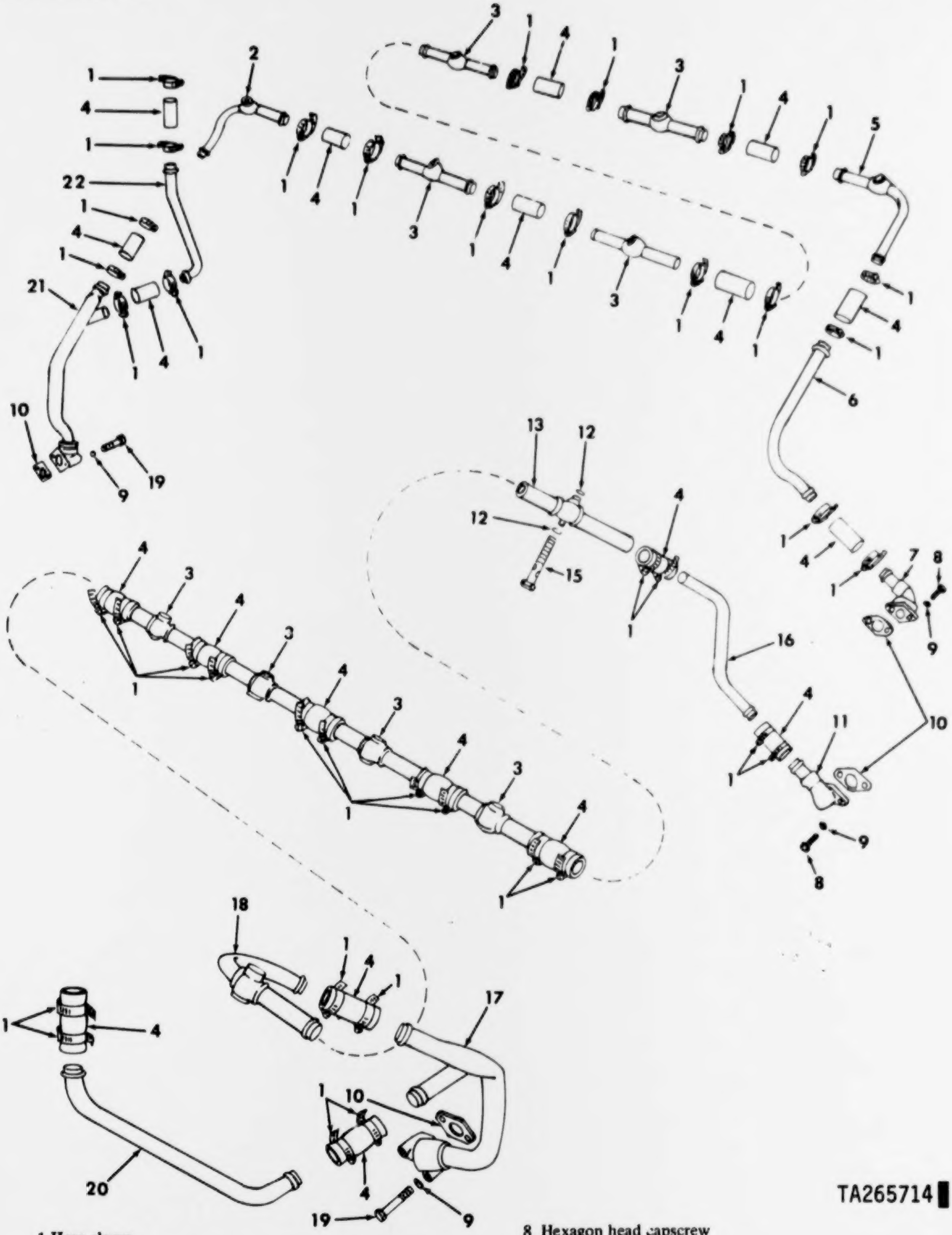
Figure 3-273. Exhaust manifold and associated parts (left bank) — exploded view.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1 Hose clamp
2 Right bank rear cylinder head oil drain tube assembly
3 Intermediate cylinder head oil drain tube
4 Rubber hose
5 Right bank front cylinder head oil drain tube assembly
6 Right bank front cylinder head oil drain tube
7 Right bank front oil pan inlet drain tube

8 Hexagon head capscrew
9 Lockwasher
10 Oil pan inlet drain flange gasket
11 Left bank front oil pan inlet drain flange to hose elbow
12 Cylinder head oil drain tube connector flat washer
13 Left bank front cylinder head oil drain tube assembly
14 Deleted

Figure 3-274. Cylinder head oil drain tubes and associated parts — exploded view.

15 Cylinder head oil drain fluid passage bolt
16 Left bank front oil pan inlet drain tube
17 Left bank rear oil pan drain tube
18 Left bank rear cylinder head oil drain tube assembly
19 Rear oil pan inlet drain tube hexagon head capscrew
20 Left bank turbosupercharger oil drain tube
21 Right bank rear oil pan drain tube
22 Right bank turbosupercharger oil drain tube

Figure 3-274. Cylinder head oil drain tubes and associated parts – exploded view – Continued

c. Oil Filler and Oil Level Indicator Tube

(1) Remove oil filler tube extension helical spring (9, fig. 3-275). Do not remove two externally relieved body screws (8) unless inspection (para 3-126*c*) indicates replacement is necessary. Screws are staked in place. Remove and discard oil filler cap preformed packing (4).

(2) Remove two machine bolts (34) securing assembled oil gage cap to left front upper cover (32) and remove assembled oil gage cap cover. Remove and discard oil level indicator neck gasket (22). Remove and discard two oil level indicator neck preformed packings (21). Remove oil gage tube helical extension spring (25). Remove and discard oil level indicator tube cap preformed packing (24). Do not remove two externally relieved screws (8) unless inspection (para 3-126*c*) indicates replacement is necessary. Bolts are staked in place.

3-125. Cleaning

Refer to paragraph 3-36.

3-126. Inspection and Repair

a. Inspect cylinder head oil drain tube assemblies for cracks, broken welds and deformation. Tube assemblies shall not leak when subjected to 25 pounds internal air pressure when submerged in water (fig. 3-274). Refer to paragraph 3-37 and 3-38 for general inspection requirements.

b. Inspect exhaust manifolds for cracks, broken welds, damaged bellows and bent flanges.

c. Inspect externally relieved screws (6 and 32, figure 3-275) for looseness or damaged shoulder area.

3-127. Assembly

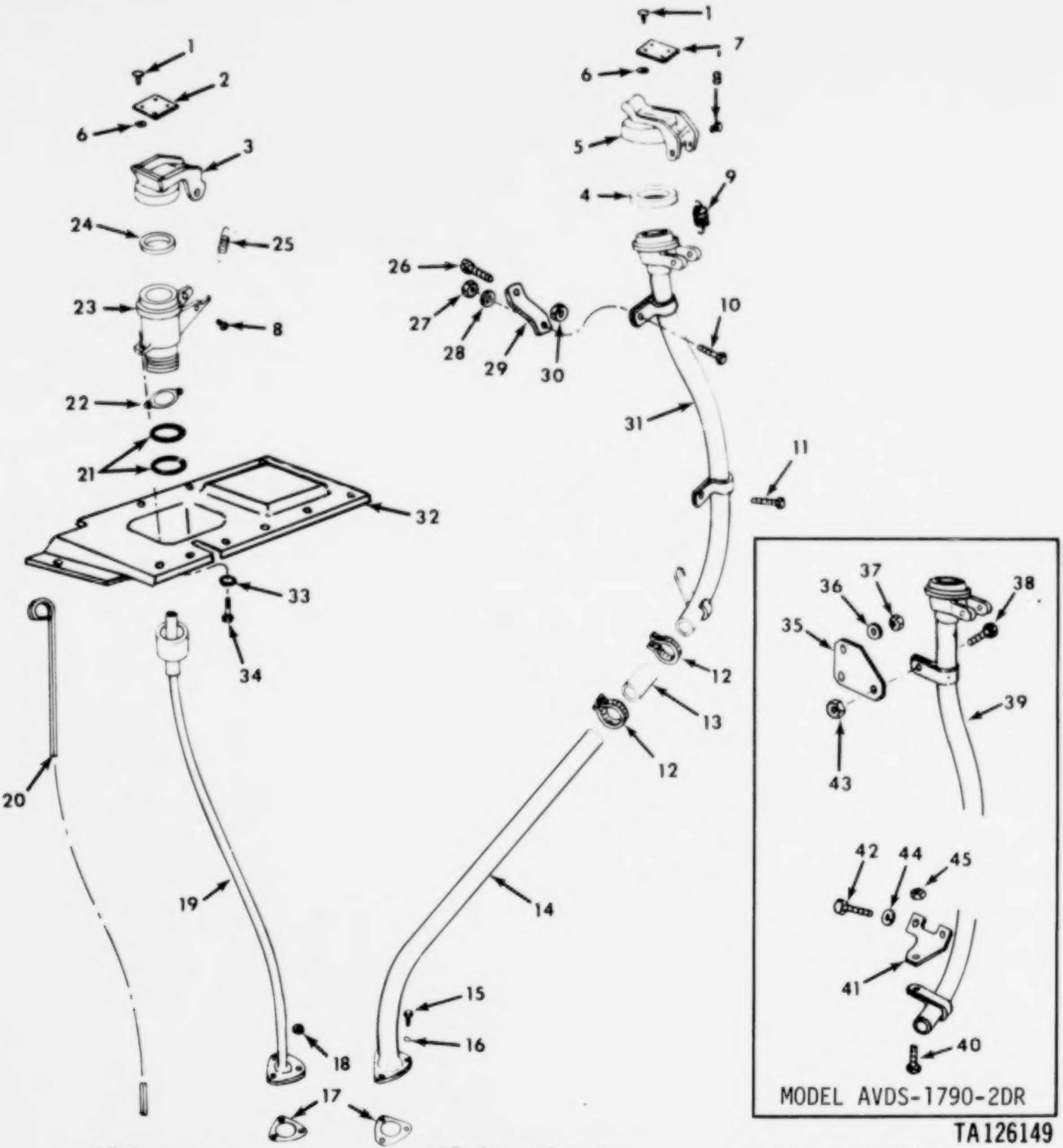
a. Oil Filler and Oil Level Indicator Tube.

(1) If necessary, install two new externally relieved body screws (8, fig. 3-275) and stake in place. Install oil level indicator tube cap preformed packing (24). Install extension helical spring (25). Install two new preformed packings (21) on oil gage rod tube neck (23). Using a new gasket (22), install assembled oil gage cap on left front upper cover (32) and secure with two machine bolts (33).

(2) Install new oil filler cap preformed packing (4) in oil filler tube cap (5). If necessary, install two new externally relieved body screws (8) and stake in place. Install oil filler tube cap extension helical spring (9).

b. Cylinder Head Oil Drain Tubes. Loosely install hose clamps (1, figure 3-274) on hoses (4) and connect rear cylinder head oil drain tube (2), four intermediate cylinder head oil drain tubes (3), right front oil drain manifold tube (5), right front cylinder head oil drain tube (6) and right bank oil pan inlet drain tube (7). Loosely install hose clamps (1) on hoses (4) and connect turbosupercharger oil drain tube (22) and right rear cylinder head oil drain tube (21).

c. Exhaust Manifolds. Exhaust manifolds will be assembled during engine assembly.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1 Drive screw
2 Identification plate
3 Cap
4 Preformed packing
5 Cap
6 Flat washer
7 Identification plate
8 Externally relieved body screw
9 Extension helical spring
10 Machine bolt
11 Machine bolt
12 Hose clamp
13 Nonmetallic hose
14 Metal tube assembly
15 Hexagon head capscrew
16 Packing with retainer
17 Gasket
18 Hexagon self-locking nut
19 Oil level gage rod tube
20 Liquid level rod gage
21 Preformed packing
22 Gasket
23 Oil gage rod tube neck
24 Preformed packing
25 Extension helical spring
26 Machine bolt
27 Hexagon self-locking nut
28 Lockwasher
29 Double angle bracket
30 Hexagon self-locking nut
31 Metal tube assembly
32 Left front upper cover
33 Lockwasher
34 Machine bolt
35 Oil filler tube support
36 Flat washer
37 Self-locking nut
38 Hexagon head capscrew
39 Metal tube assembly
40 Hexagon head capscrew
41 Oil filler tube support
42 Hexagon head capscrew
43 Hexagon self-locking nut
44 Lockwasher
45 Hexagon self-locking nut

Figure 3-275. Oil filler and oil level indicator tubes and associated parts – exploded view.

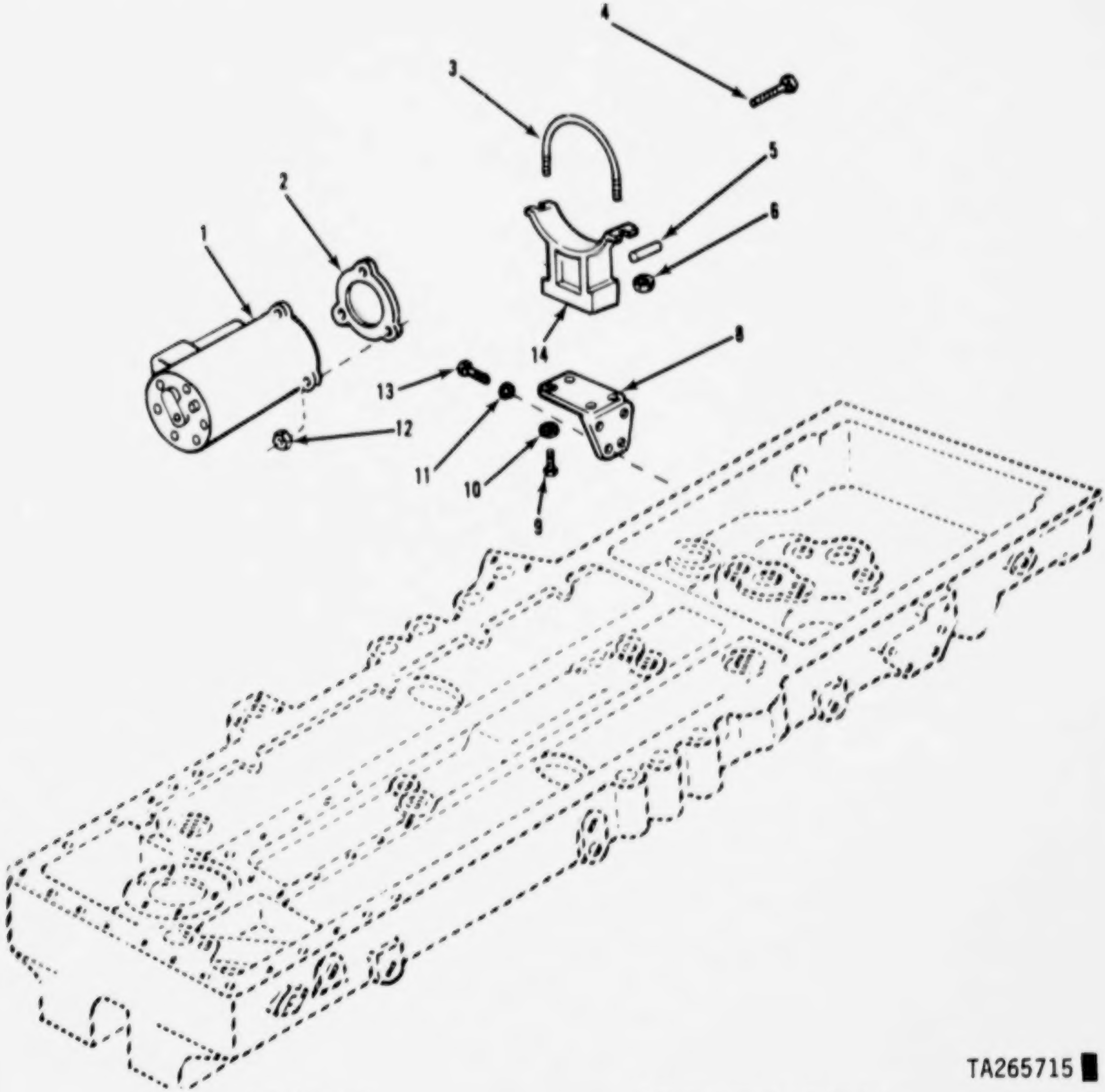
Section XXI. REPAIR OF GENERATOR AND STARTER SUPPORTS

3-128. General

This section covers the repair of the generator and starter supports. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operations.

3-129. Disassembly

a. Starter Support. Remove four screws (9, fig. 3-276) and flat washers (10) attaching starter cradle assembly (14) to starter support angle bracket (8) and separate cradle from support.



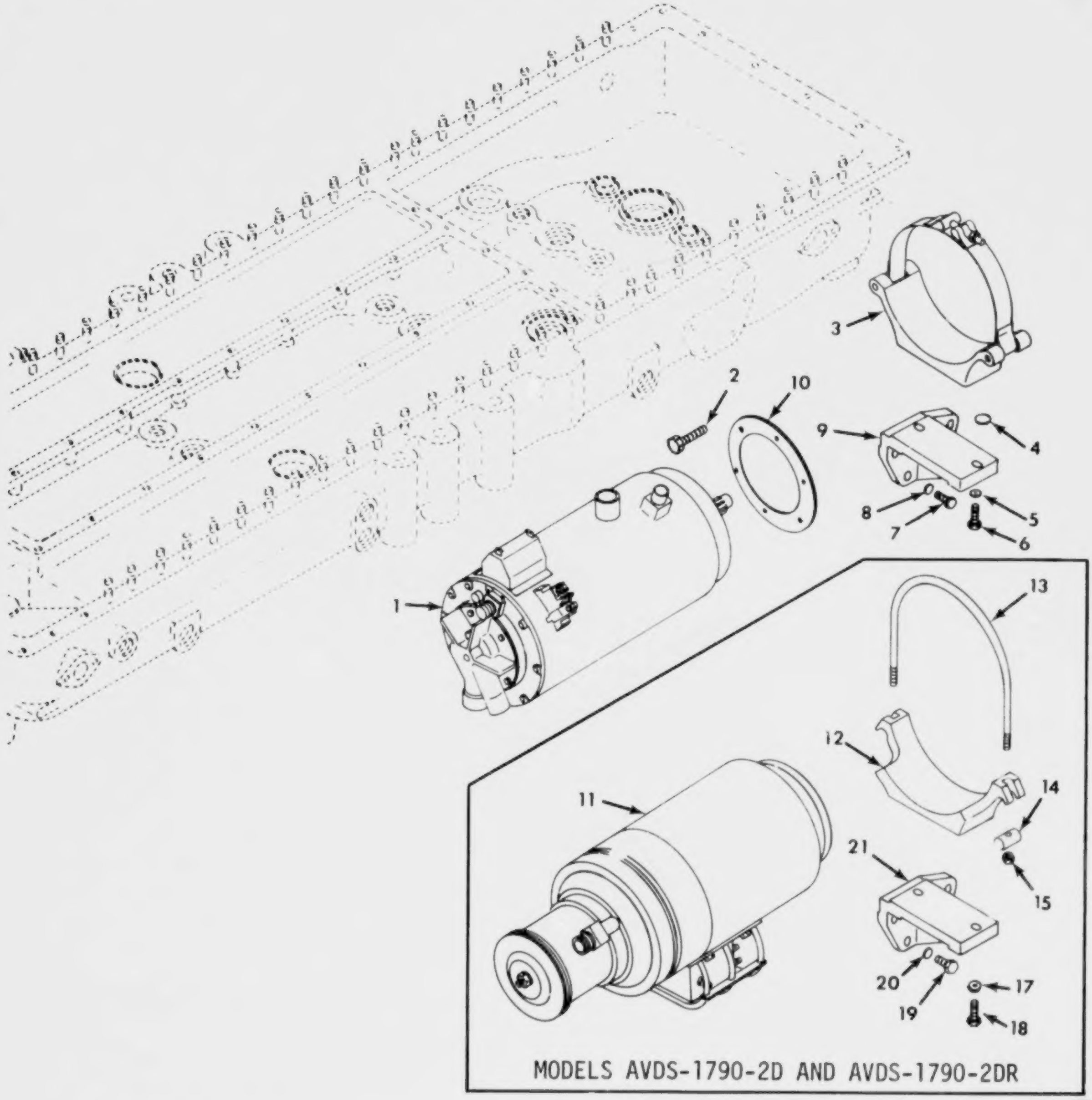
TA265715

1 Engine starter
2 Starter mounting gasket
3 Starter U bolt
4 Machine bolt
5 Starter clamping bar
6 Self-locking nut
7 Deleted
8 Starter support angle bracket
9 Screw
10 Flat washer
11 Flat washer
12 Self-locking nut
13 Screw
14 Cradle

Figure 3-276. Engine starter, cradle support and associated parts – exploded view.

b. Generator Support. (Model AVDS-1790-2C Engine). Remove two machine screws (6, figure 3-277) and flat washers (5) attaching generator cradle (3) to generator cradle angle bracket (9) and separate cradle from bracket.

c. Generator Support. (Model AVDS-1790-2D and AVDS-1790-2DR Engines.) Remove two screws and flat washers (17) attaching generator cradle (12) to bracket (21) and separate cradle from bracket.



TA265716

1 Engine generator
2 Self-locking bolt
3 Generator cradle assembly
4 Insert
5 Flat washer
6 Machine screw
7 Hexagon head capscrew
8 Flat washer
9 Bracket
10 Gasket
11 Engine generator
12 Cradle
13 Cradle U bolt
14 Clamping bar
15 Self-locking nut
16 Deleted
17 Flat washer
18 Screw
19 Machine screw
20 Flat washer
21 Bracket

Figure 3-277. Engine generator, cradle support and associated parts — exploded view.

3-130. Cleaning, Inspection and Repair

a. Cleaning. Refer to paragraph 3-36.

b. Inspection and Repair. Refer to paragraphs 3-37 and 3-38. Refer to paragraph 3-39 when replacing screw thread inserts.

3-131. Assembly

a. Generator Support. (Model AVDS-1790-2C Engine). Loosely attach generator cradle (3, figure 3-277) to generator cradle angle bracket (9) with two machine screws (6) and flat washers (5).

b. Generator Support. (Model AVDS-1790-2D and AVDS-1790-2DR Engines). Loosely attach generator cradle (12) to angle bracket (21) with two screws (18) and flat washers (17).

c. Starter Support. Loosely attach starter cradle assembly (14, fig. 3-276) to starter support angle bracket (8) with four screws (9) and flat washers (10).

Section XXII. REPAIR OF FUEL BACKFLOW VALVE, PRIMARY FUEL FILTER, FUEL/WATER SEPARATOR, AND ASSOCIATED PARTS

3-132. General

This section covers the repair of the fuel backflow valve, primary fuel filter, fuel/water separator, automatic drain system, and associated parts. Specific instructions on disassembly, cleaning, inspection and assembly accompany the repair operations.

3-133. Fuel Backflow Valve

a. Disassembly. Remove backflow valve outlet adapter (13, fig. 3-278) from fuel backflow valve (29). Remove manifold heater fuel inlet tube (44, fig. 3-267), and inlet tube adapter (35) from backflow valve inlet tee (39). Remove fuel filter elbow (42) (Model AVDS-1790-2C only), main fuel supply filter (41) and purge pump inlet tee reducer (40) from inlet tee (39). Remove backflow valve inlet tee (39), and backflow valve inlet adapter (12, fig. 3-278) from backflow valve (29).

a.1. Disassembly. Remove pipe to tube straight adapter (45, fig. 3-278) from fuel backflow valve (46). Remove pipe to tube straight adapter (35) from backflow valve.

b. Cleaning, Inspection and Repair. Refer to paragraphs 3-36, 3-37, and 3-38. Inspect plastic tube (44, fig. 3-267) for internal diameter reduction at tube nut ferrule. Inspect tube fittings for stripped or damaged threads. Replace tube if it is kinked, split, or fittings are damaged. Replace tube when internal diameter is reduced enough to restrict fuel flow. When replacing tube (45, fig. 3-267) install insert tube fittings (46) in both ends of tube.

c. Test and Adjustment.

(1) Fill fuel backflow valve with test fluid, MIL-F-7024A, Type II, and apply a pressure of 1/2 psi to port markedd "FREE FLOW" (fuel inlet from primary fuel filter). The backflow valve must open at this pressure. Valve operation can be determined when fluid flows from the fuel pump outlet port (fig. 3-279).

(2) Apply a pressure of 85 to 95 psi to the heater pump inlet port. The check ball must bypass fluid at this pressure. Adjust slotted head adjusting screw to obtain this opening pressure.

(3) Plug the fuel pump outlet port, and the heater pump outlet port, and apply a pressure of 100 psi at heater pump inlet port. There should be no fuel leakage from the "FREE FLOW" port.

(4) If the valve fails to pass either test, replace entire valve assembly.

d. Assembly. Install backflow valve inlet adapter (12, fig. 3-278) and backflow valve inlet tee (39, fig. 3-267) in backflow valve (29, fig. 3-278). Install purge fuel supply filter (41, fig. 3-267) and fuel filter elbow (42) (Model AVDS-1790-2C Engine only) in backflow valve inlet tee (39) with purge pump inlet tee reducer (40). Install tube adapter (35), and manifold heater fuel inlet tube (44) in backflow valve inlet tee (39). Install backflow valve outlet adapter (13, fig. 3-278).

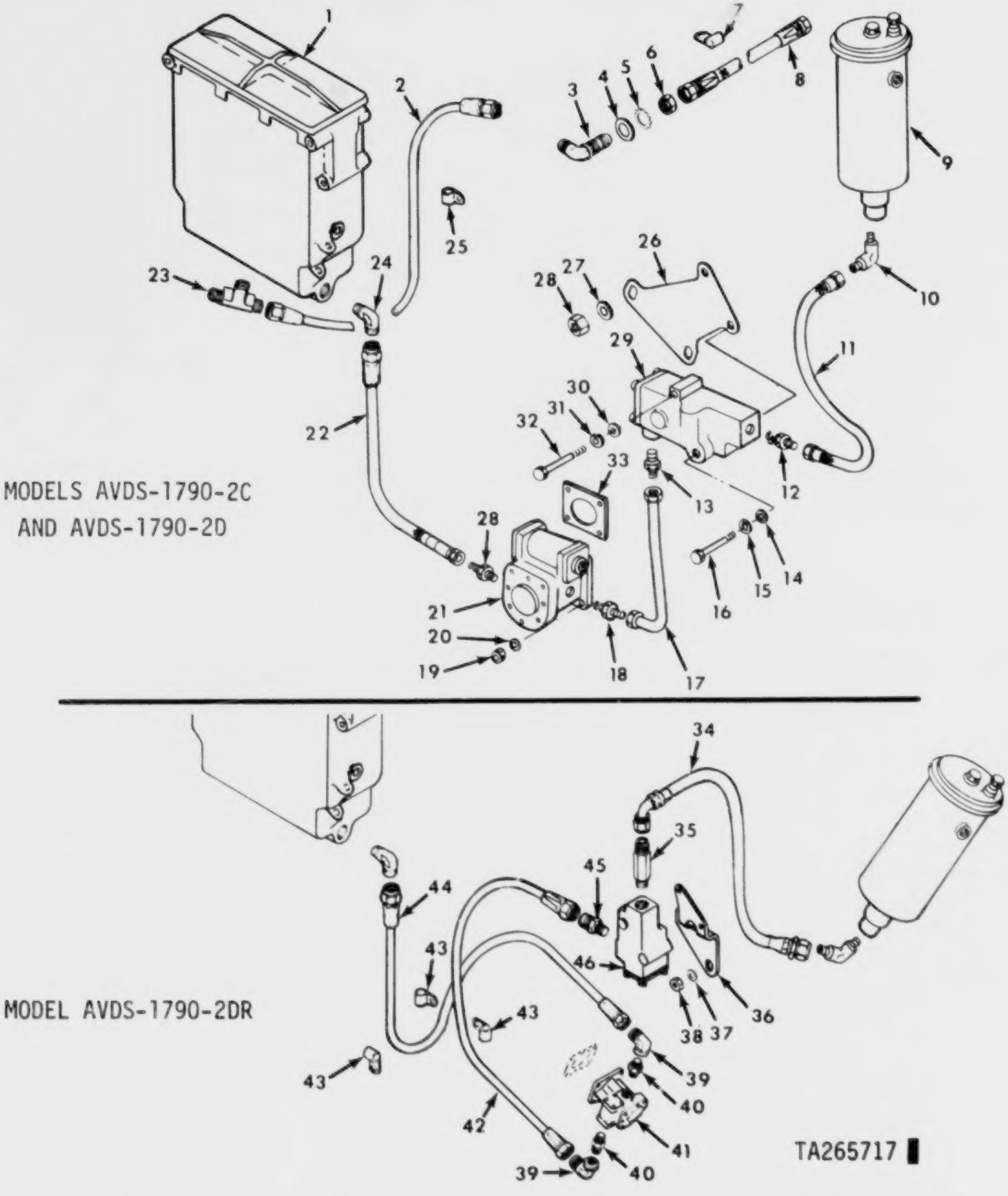
d.1. Install pipe to tube straight adapter (35, fig. 3-278) in backflow valve (46). Install pipe to tube straight adapter (45) in backflow valve.

3-134. Primary Fuel Filter

a. Disassembly.

(1) Remove fuel filter outlet elbow (10, fig. 3-278), and constant bleed adapter (10, fig. 3-282) from primary filter. Loosen two self-locking nuts (26) and remove primary filter (11) from filter bracket (25).

Table 3-27. Deleted.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MODELS AVDS-1790-2C
AND AVDS-1790-2D
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MODEL AVDS-1790-2DR
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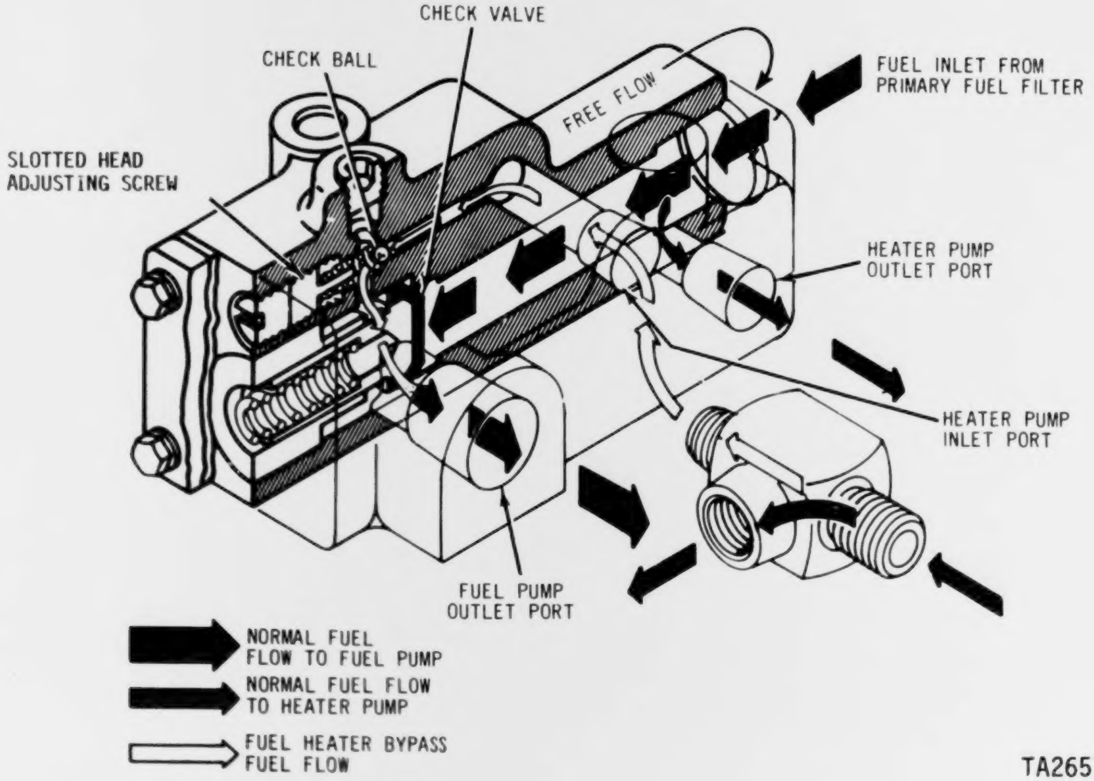
TA265717

1	Fluid pressure filter water separator	12	Inlet adapter	24	Outlet elbow	36	Mounting bracket
2	Hose assembly	13	Outlet adapter	25	Loop clamp	37	Flat washer
3	Hose elbow	14	Flat washer	26	Bracket	38	Self-locking nut
4	Flat washer	15	Lockwasher	27	Flat washer	39	Pipe to tube elbow
5	Lockwasher	16	Capscrew	28	Self-locking nut	40	Pipe nipple
6	Plain nut	17	Tube assembly	29	Backflow valve	41	Fuel pump
7	Loop clamp	18	Inlet adapter	30	Flat washer	42	Nonmetallic hose assembly
8	Hose assembly	19	Self-locking nut	31	Lockwasher	43	Loop clamp
9	Primary fuel filter	20	Flat washer	32	Capscrew	44	Nonmetallic hose assembly
10	Outlet elbow	21	Fuel pump	33	Gasket	45	Pipe to tube straight adapter
11	Hose assembly	22	Hose assembly	34	Nonmetallic hose assembly	46	Backflow valve
		23	Inlet tee	35	Pipe to tube straight adapter		

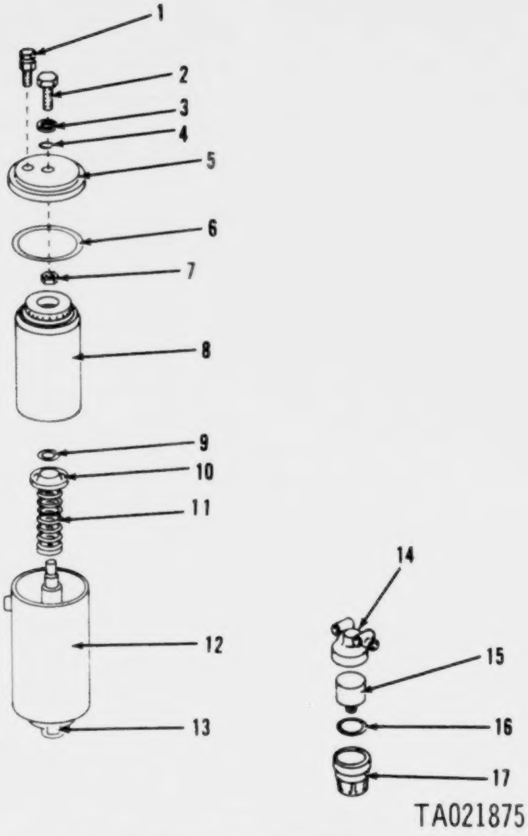
Figure 3-278. Fuel pump, backflow valve, fuel lines and fittings - exploded view.


CHECK VALVE
CHECK BALL
FREE FLOW
FUEL INLET FROM PRIMARY FUEL FILTER
SLOTTED HEAD ADJUSTING SCREW
HEATER PUMP OUTLET PORT
HEATER PUMP INLET PORT
FUEL PUMP OUTLET PORT
NORMAL FUEL FLOW TO FUEL PUMP
NORMAL FUEL FLOW TO HEATER PUMP
FUEL HEATER BYPASS FUEL FLOW

TA265718

Figure 3-279. Fuel backflow valve flow diagram.

(2) Loosen retaining screw (2, fig. 3-280) and remove primary fuel filter head (5) from body assembly (12). Remove and discard gasket (6).



1 Primary fuel filter bleeder valve
2 Retaining screw
3 Flat washer
4 Primary fuel filter retaining screw gasket
5 Primary fuel filter head
6 Primary fuel filter head gasket
7 Lock nut
8 Primary fuel filter element
9 Preformed packing
10 Primary fuel filter retainer assembly
11 Primary fuel filter element compressor spring
12 Primary fuel filter body assembly
13 Constant bleed fuel adapter fitting
14 Manifold heater filter head
15 Manifold heater fuel filter element
16 Preformed packing
17 Manifold heater fuel filter

Figure 3-280. Primary fuel filter, and manifold heater fuel filter assemblies — exploded view.

(3) Remove lock nut (7) and retaining screw (2). Remove and discard flat washer (3) and gasket (4). Remove bleeder valve (1) from filter head (5).

(4) Remove and discard primary fuel filter element (8). Remove retainer assembly (10) and helical compression spring (11) from body (12). Remove and discard preformed packing (9). Remove fitting (13).

b. Cleaning, Inspection and Repair. Refer to paragraphs 3-36, 3-37 and 3-38. Check constant bleed fuel adapter fitting (10, fig. 3-282) for blockage. Constant bleed orifice must be open.

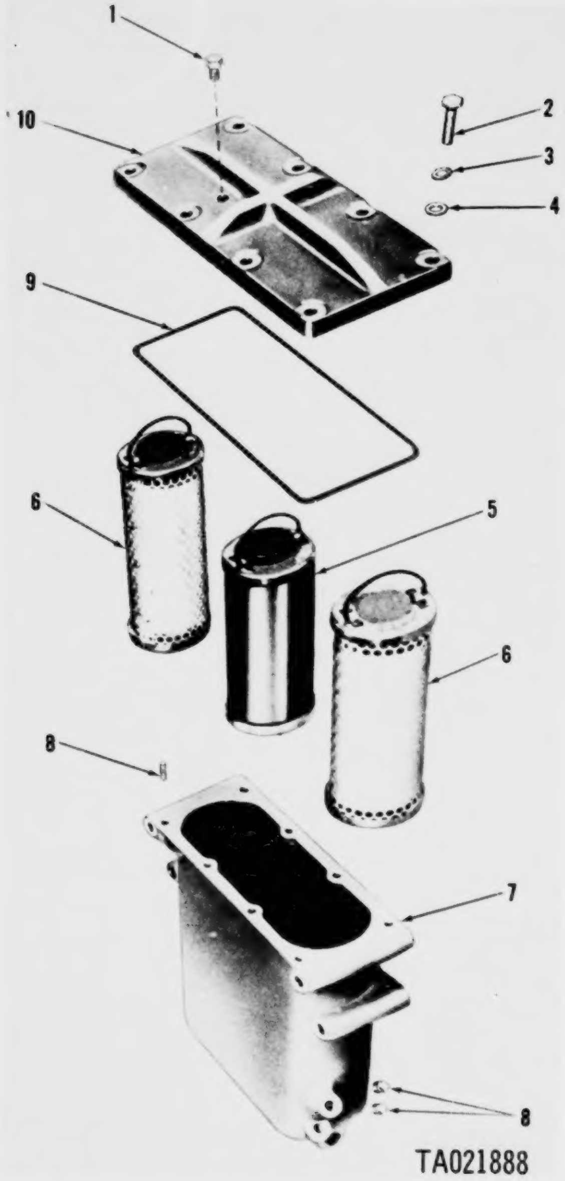
c. Assembly.

(1) Install helical compression spring (11, fig. 3-280) in filter body (12). Install a new preformed packing (9) in retainer assembly (10) and install retainer and packing in body. Install new filter element (8).

(2) Install bleeder valve (1) in filter head (5). Install a new flat washer (3) and gasket (4) on retaining screw (2) and install screw in filter head (5). Secure flat washer gasket and screw to head with lock nut (7).

(3) Using a new gasket (6) install assembled head on filter body (12) and secure by tightening retaining screw (2). Install fitting (13).

(4) The mounting brackets, fuel hoses and fittings are installed during engine assembly.



1 Fuel filter water separator bleed valve
2 Hexagon head capscrew
3 Lockwasher
4 Flat washer
5 Final water separator filter
6 Water separator filter element
7 Water separator fuel filter body
8 Insert
9 Preformed packing
10 Water separator cover

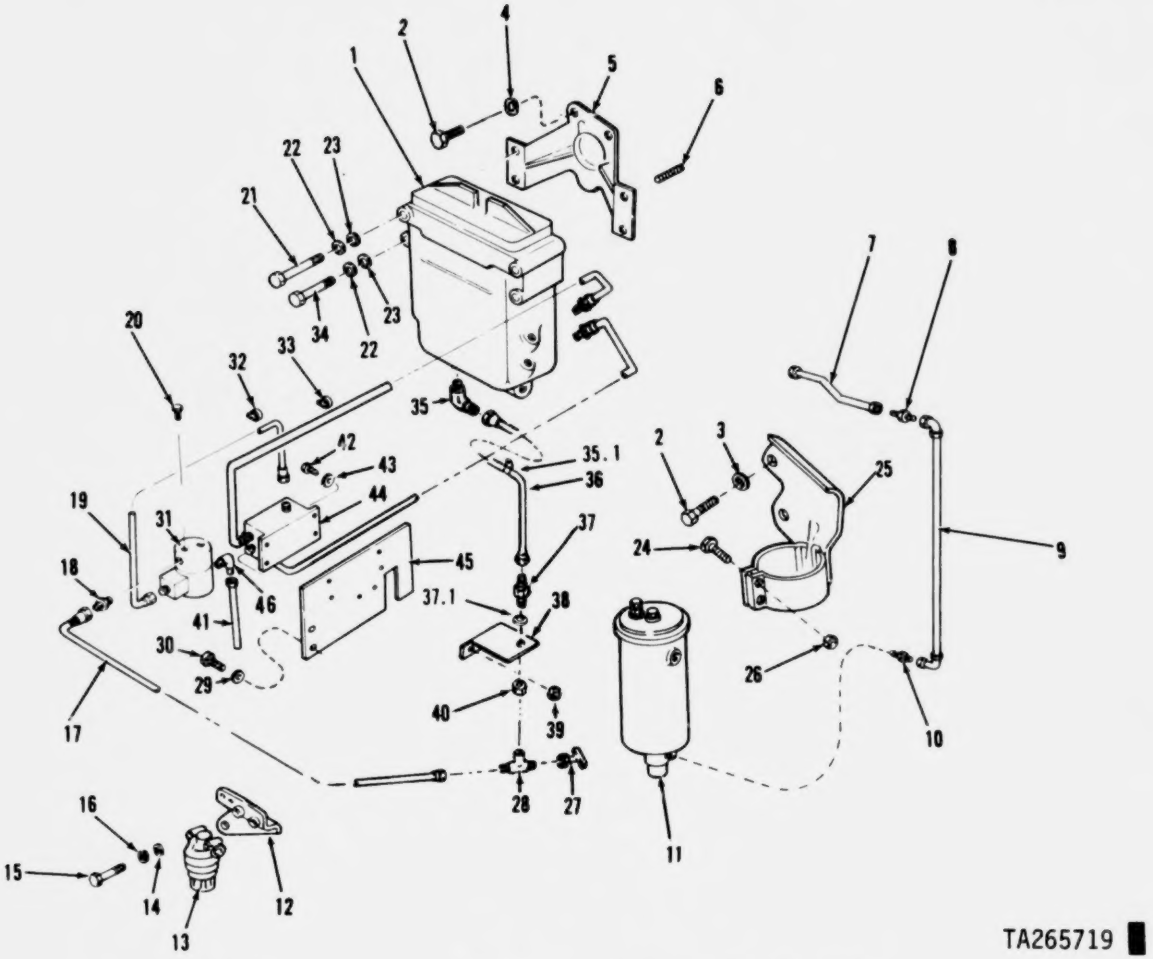
Figure 3-281. Water/separator fuel filter — exploded view.

3-135. Fuel/Water Separator Filter and Automatic Drain System

a. Disassembly.

(1) ***Fuel/water separator filter.***

(a) Remove fuel inlet elbow (24, fig. 3-278) and fuel outlet tee (23), from water separator fuel filter (1). Remove fuel drain elbow (35, fig. 3-282) from water separator fuel filter (1).



1	Water separator filter
2	Hexagon head capscrew
3	Deleted
4	Flat washer
5	Fuel water separator bracket
6	Screw thread insert
7	Primary fuel filter bleed hose assembly
8	Bulkhead union
9	Primary fuel filter constant bleed hose assembly
10	Primary fuel filter constant bleed hose adapter
11	Primary fuel filter
12	Manifold heater fuel filter bracket
13	Manifold heater fuel filter
14	Flat washer
15	Machine screw
16	Lockwasher
17	Fuel filter water separator drain hose assembly
18	Fuel filter water separator drain hose adapter
19	Automatic water drain wiring harness
20	Solenoid assembled washer bolt
21	Water separator machine bolt
22	Lockwasher
23	Flat washer
24	Hexagon head capscrew
25	Primary fuel filter bracket
26	Self-locking nut
27	Drain valve
28	Drain valve tee
29	Lockwasher
30	Machine bolt
31	Fuel filter water separator solenoid valve
32	Electrical lead loop clamp
33	Automatic water drain sensor lead loop clamp
34	Water separator machine bolt
35	Drain valve elbow
35.1	Loop clamp
36	Fuel filter water connector drain hose assembly
37	Bulkhead connector
37.1	Washer
38	Angle bracket
39	Self-locking nut
40	Nut
41	Solenoid outlet drain tube assembly
42	Control module assembled washer bolt
43	Flat washer
44	Automatic drain control module
45	Fuel water separator control mounting plate
46	Solenoid outlet elbow

Figure 3-282. Primary fuel filter, water/separator fuel filter, water separator automatic drain control module, and solenoid valve and associated parts – exploded view.

(b) Remove bleeder valve (1, fig. 3-281) from water separator cover (10). Remove eight water separator cover capscrews (2) and flat washers (4) and remove cover from fuel filter body (7). Remove and discard preformed packing (9), final water separator filter (5) and two outer water separator filter elements (6).

(2) *Automatic drain system.*

(a) Disconnect automatic water drain wiring harness (19, fig. 3-282) from water separator control module (44). Remove three assembled washer bolts (42) and flat washers (43) attaching module and electrical lead loop clamp (32), to mounting plate (45). Remove loop clamp from wiring harness and control module from bracket.

(b) Remove automatic water drain wiring harness (19) from water separator automatic drain solenoid valve (31). Remove automatic drain solenoid valve tube assembly (41) from elbow (46).

(c) Remove two assembled washer bolts (20) and remove solenoid valve (31) from bracket (45). Remove adapter (18) from solenoid valve "IN" opening, and elbow (46) from "OUT" opening.

(d) Disconnect and remove hose assembly (17, fig. 3-282) from drain valve tee (28). Remove nut and washer securing loop clamp (35.1). Disconnect and remove hose assembly (36) from bulkhead connector (37). Remove angle bracket (4) from bulkhead connector and remove bulkhead connector and drain valve (21) from tee.

b. Cleaning, Inspection and Repair.

(1) Refer to paragraphs 3-36, 3-37, and 3-38.

(2) Visually inspect the drain control module and probes assembly for cracks, dents, damaged threads and torn or frayed insulation on the probe leads. Check to be certain red shrink tubing is intact on upper probe lead for identification. Replace damaged modules.

(3) Functionally inspect the control assembly as follows:

(a) Connect a 24-vdc power supply to the power supply (left side) connector of the control. Make certain the positive (+) lead is connected to pin A and the negative lead is connected to pin B.

(b) Connect a dc voltmeter to the power output (right side) connector of the control. Make certain the meter positive (+) lead is connected to pin A and the negative lead is connected to pin B.

(c) Turn power supply on. Lightly press the tip of the low (short) probe to the negative (-) terminal of the 24-vdc power supply. The voltmeter should show zero voltage.

(d) Continue to hold the low probe on the terminal and lightly press the tip of the high (identified by red shrink tube) probe to the terminal also. The voltmeter should now show 24 volts.

(e) Remove the high probe only. The meter should continue to show 24 volts for 18 (±3) seconds and then drop to zero volts.

(f) Continue to hold the low probe to the terminal and again press the high probe to the terminal. The voltmeter should continue to show zero volts.

(g) Continue to hold both probes on the terminal. Turn the power supply off for one second or longer. Turn on the power supply and the voltmeter should again show 24 volts.

(h) Remove the high probe from the terminal and the meter should continue to show 24 volts. Remove the low probe from the terminal in less than 15 seconds and the meter should return to zero volts.

(i) Again press the low probe and then the high probe to the terminal and meter should return to 24 volts.

(j) Modules that do not respond as in *(c)* through *(i)* above are not functioning correctly and must be replaced.

c. Assembly.

(1) *Automatic drain system.*

(a) Install adapter (18) in solenoid valve (31) "IN" opening and elbow (46) in "OUT" opening and install assembled solenoid valve on bracket (45) and secure with two assembled washer bolts (20).

(b) Install automatic drain solenoid valve tube assembly (41) on elbow (46). Install automatic drain wiring harness (19) on automatic drain solenoid valve (31).

(c) Attach loop clamp (32) on automatic drain wiring harness (19). Install control module (44) on mounting plate (45) and wiring harness loop clamp on control module. Secure control module and loop clamp to mounting bracket with three assembled washer bolts (42) and flat washers (43). Connect automatic water drain wiring harness (19) to control module (44).

(d) Install drain valve (27) and bulkhead connector (37) and tee (28), and install angle bracket (38) on bulkhead connector. Install hose assembly (36) on bulkhead connector and hose assembly (17) on tee. Attach loop clamp (35.1) with nut and washer.

(2) *Fuel/water separator filter.*

(a) Install two new outer water separator filter elements (6, fig. 3-281) and a new final filter element (5) in filter body (7). Using a new preformed packing (9) install cover (10) on fuel filter body and secure with eight capscrews (2), lockwashers (3) and flat washers (4). Install bleeder valve (1) in separator cover.

(b) Install fuel drain elbow (35, fig. 3-282) in fuel/water separator filter. Install fuel outlet elbow (2, fig. 3-279) and fuel inlet elbow (30) in fuel/water separator filter (1).

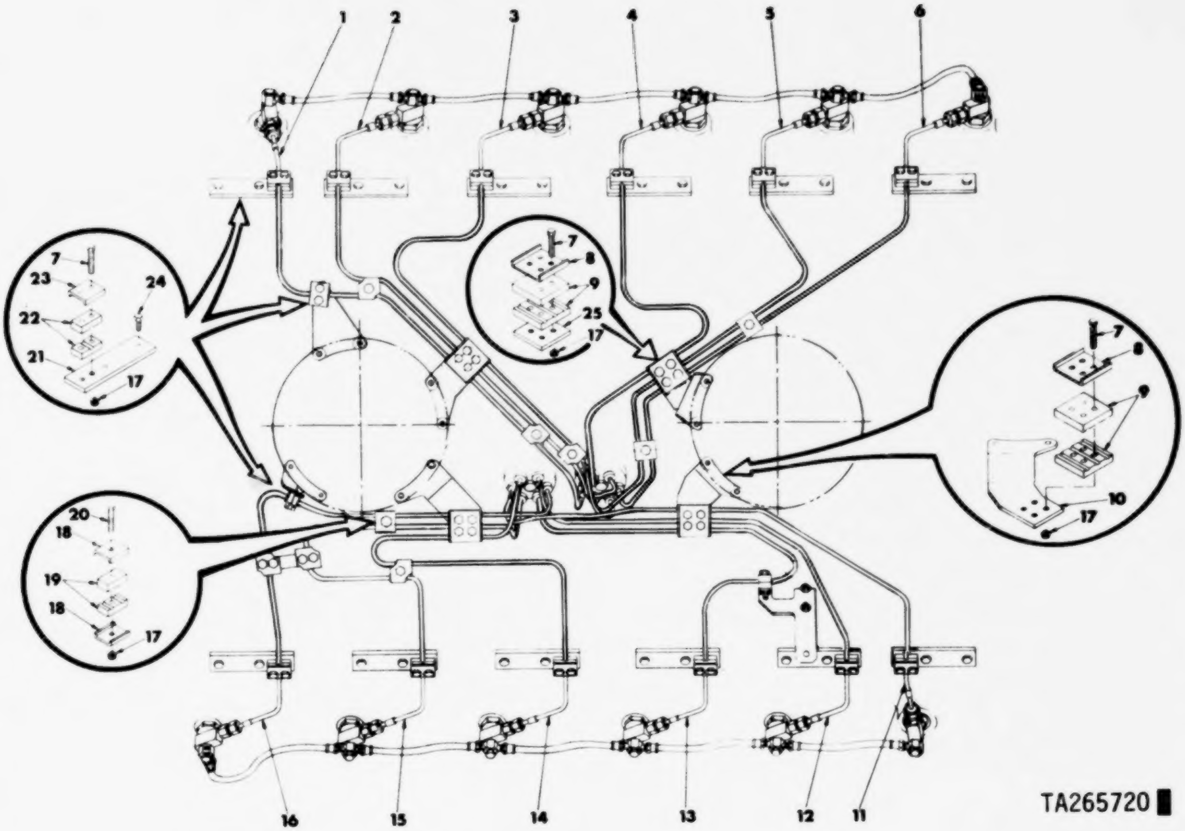
Section XXIII. REPAIR OF FUEL INJECTION PUMP FUEL TUBES, FUEL INJECTOR NOZZLE FUEL RETURN TUBES, INJECTION PUMP AND TURBOSUPERCHARGER OIL HOSES, GENERATOR OIL LINES, GENERATOR AIR DUCTING, AND ASSOCIATED PARTS

3-136. General

This section covers the repair of the fuel injection pump fuel tubes, fuel injector nozzle fuel return tubes, injection pump and turbosupercharger oil hoses, generator oil lines and associated parts. Specific instructions on disassembly, cleaning, and inspection accompany the repair operations.

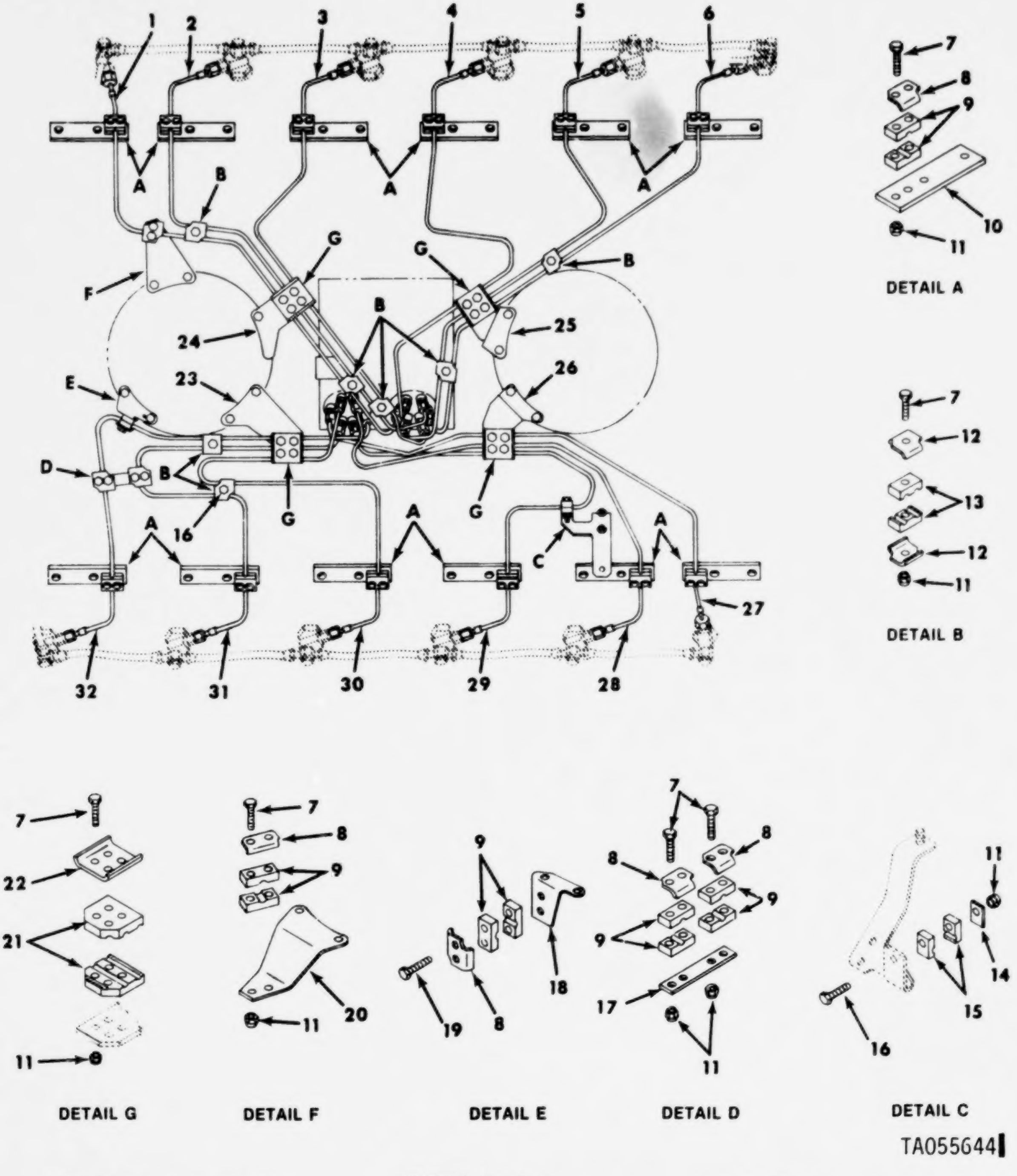
3-137. Fuel Injection Pump Fuel Tubes, Fuel Return Hoses and Nozzle Fuel Return Tubes

a. Disassembly. The fuel injection pump fuel tubes (figs. 3-283 and 3-283.1) and nozzle fuel return tubes (figs. 3-284 and 3-284.1) were disassembled during disassembly of the engine.



1 No. 6R fuel injector tube assembly
2 No. 5R fuel injector tube assembly
3 No. 4R fuel injector tube assembly
4 No. 3R fuel injector tube assembly
5 No. 2R fuel injector tube assembly
6 No. 1R fuel injector tube assembly
7 Self-locking bolt
8 Fuel tube clamp plate (three tube)
9 Fuel injector tube clamp (three tube)
10 Support bracket
11 No. 1L fuel injector tube assembly
12 No. 2L fuel injector tube assembly
13 No. 3L fuel injector tube assembly
14 No. 4L fuel injector tube assembly
15 No. 5L fuel injector tube assembly
16 No. 6L fuel injector tube assembly
17 Hexagon self-locking nut
18 Fuel tube clamp plate (two tube)
19 Fuel injector tube clamp (two tube)
20 Hexagon head capscrew
21 Fuel injection line support
22 Fuel injector tube clamp (one tube)
23 Fuel tube clamp plate (one tube)
24 Hexagon head capscrew
25 Fuel injection tube plate (three tube)

Figure 3-283. Fuel injector tubes, clamp and associated parts, model AVDS-1790-2C and AVDS-1790-2D engines.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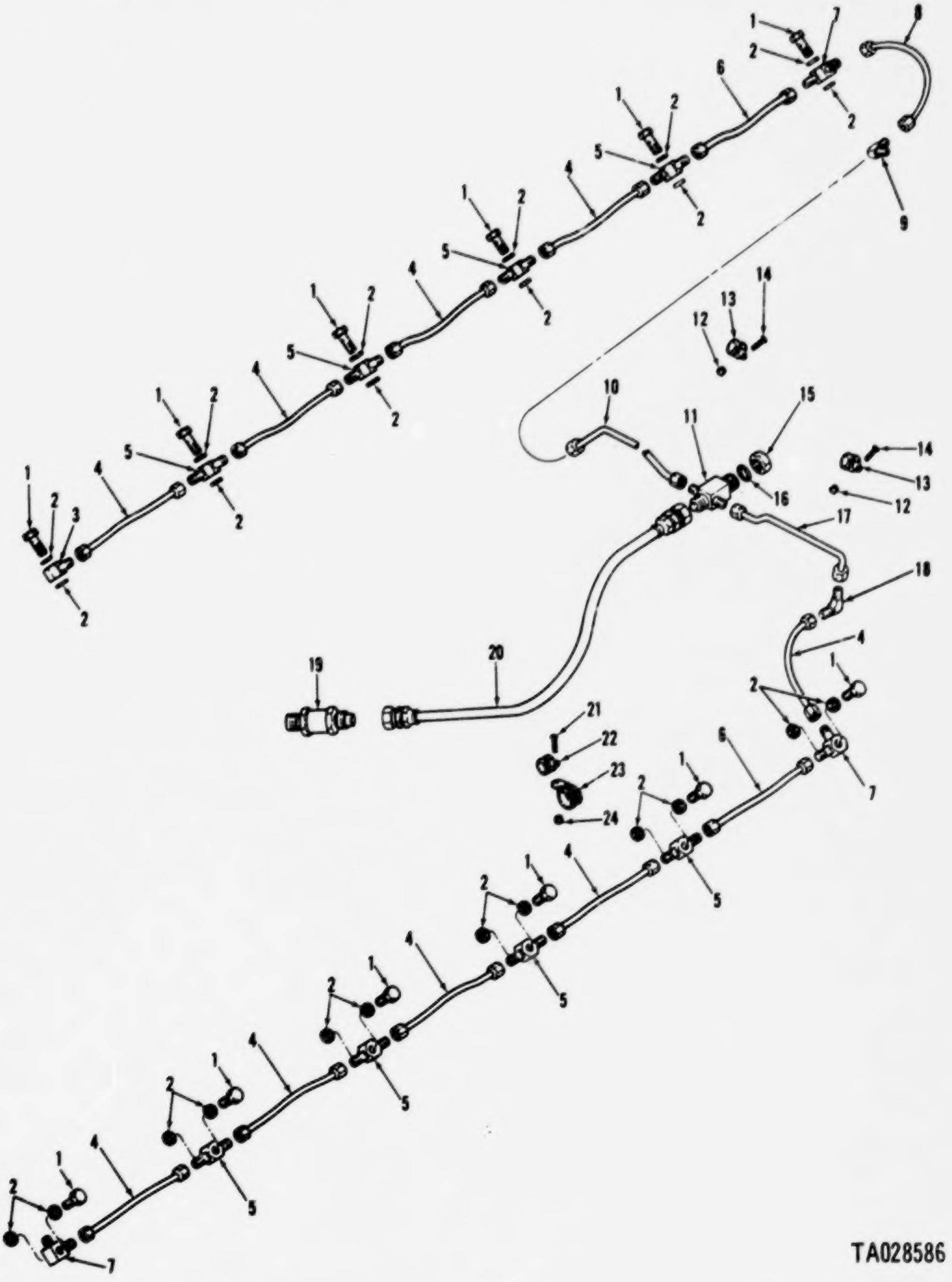
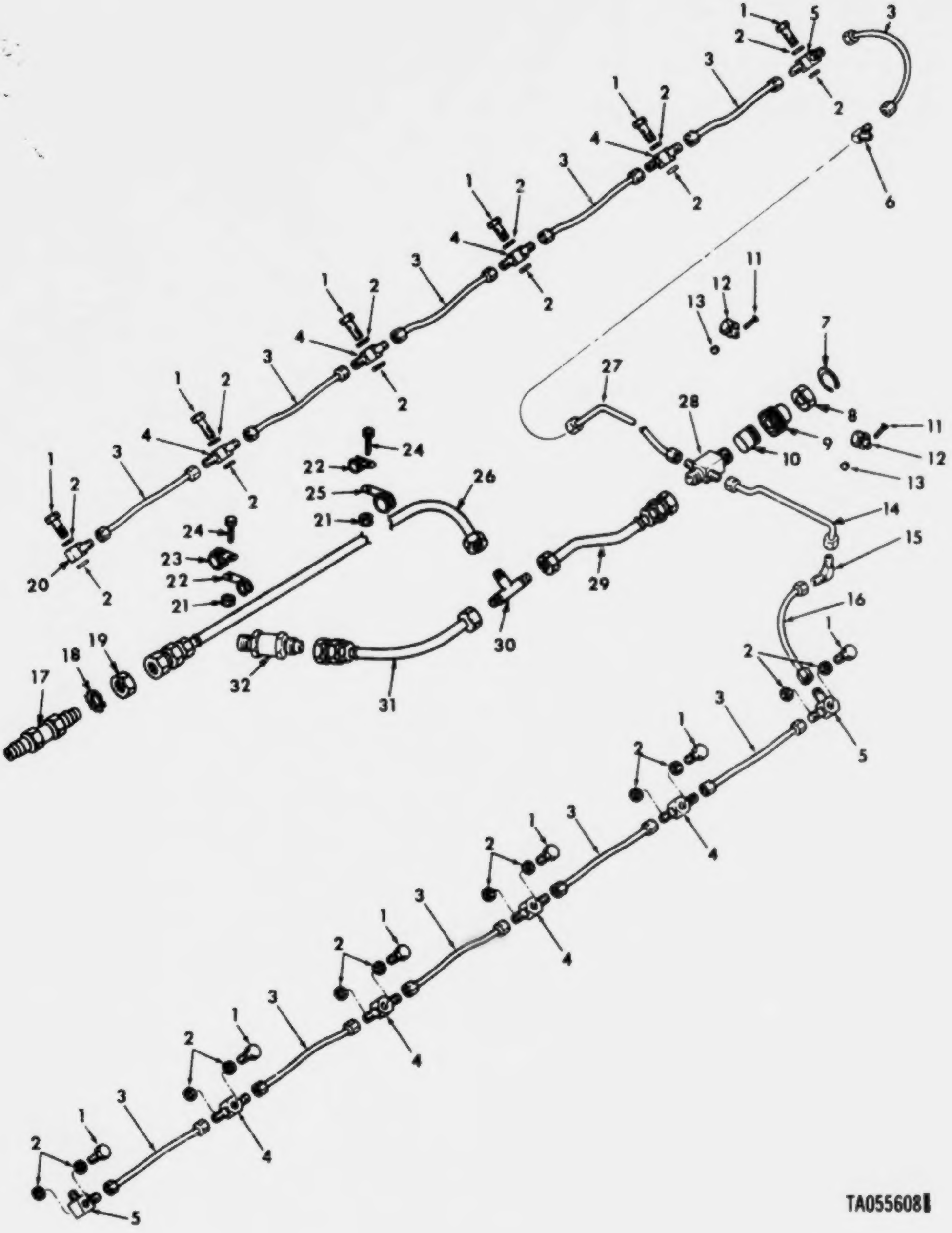
1 No. 6R metal tube assembly
2 No. 5R metal tube assembly
3 No. 4R metal tube assembly
4 No. 3R metal tube assembly
5 No. 2R metal tube assembly
6 No. 1R metal tube assembly
7 Machine bolt
8 Retaining strap
9 Tubular fairlead half
10 Plate spacer
11 Hexagon self-locking nut
12 Retaining strap
13 Tubular fairlead half
14 Retaining strap
15 Tubular fairlead half
16 Machine bolt
17 Plate spacer
18 Angle bracket
19 Self-locking bolt
20 Double angle bracket
21 Tubular fairlead half
22 Retaining strap
23 Double angle bracket
24 Double angle bracket
25 Double angle bracket
26 Double angle bracket
27 No. 1L metal tube assembly
28 No. 2L metal tube assembly
29 No. 3L metal tube assembly
30 No. 4L metal tube assembly
31 No. 5L metal tube assembly
32 No. 6L metal tube assembly

Figure 3-283.1. Fuel injector tubes, clamp and associated parts, model AVDS-1790-2DR engine.



1 Fluid passage bolt
2 Flat washer
3 Fluid connector
4 Fuel return hose assembly
5 Fluid tee connector
6 No. 5-6 right and left fuel return hose assembly
7 Fluid elbow connector
8 Fuel return hose
9 Elbow
10 No. 6 left fuel return hose assembly
11 Tube cross
12 Nut
13 Clamp
14 Machine screw
15 Plain nut
16 Flat washer
17 No. 6 right fuel return tube assembly
18 Elbow
19 Fuel return check valve
20 Fuel injection pump fuel return hose assembly
21 Machine screw
22 Loop clamp
23 Loop clamp
24 Hexagon self-locking nut

Figure 3-284. Fuel injector and nozzle fuel return hoses – exploded view, model AVDS-1790-2C and AVDS-1790-2D engines.



1 Passage fluid bolt
2 Flat washer
3 Nonmetallic hose assembly
4 Pressure line fluid multiple connector
5 Pressure line fluid multiple connector
6 Tube elbow
7 Retaining ring
8 Coupling tube nut
9 Tube clinch sleeve
10 Sealing plug assembly
11 Assembled washer bolt
12 Loop clamp
13 Hexagon self-locking nut
14 Metal tube assembly
15 Tube elbow
16 Nonmetallic hose assembly
17 Tube nipple
18 Lockwasher
19 Hexagon plain nut
20 Pressure fluid connector
21 Hexagon self-locking nut
22 Loop clamp
23 Loop clamp
24 Machine screw
25 Loop clamp
26 Nonmetallic hose assembly
27 Metal tube assembly
28 Tube cross
29 Nonmetallic hose assembly
30 Tube tee
31 Nonmetallic hose assembly
32 Check valve

Figure 3-284.1. Fuel injector and nozzle fuel return hoses – exploded view, model AVDS-1790-2DR engine.

b. Cleaning, Inspection and Repair.

(1) *General.* Refer to paragraphs 3-36 through 3-38.

(2) *Fuel Injection Pump Fuel Tubes.* Flush the fuel tube assemblies with a high pressure flushing device. After flushing, blow dry with compressed air and plug tube ends with plugs or caps to assure cleanliness. Inspect tubes for correct inside diameter hose dimension. The correct inside dimension is 0.0815-0.0865-inch. Tubes with larger or smaller hole diameter are to be discarded. Carefully inspect all tubes for proper configuration using a current preformed tube of like function for comparison. Excessive bending or hand forming creates high stress points and greatly reduces tube life. Discard any tube that deviates from preformed comparison tube configuration. Inspect tube assemblies for cracks, splits or kinks. Inspect the compression sleeves (fig. 3-285), compression nuts, support sleeves and support nuts for defects or damage. Refer to figure 3-285 for comparison of sleeve fittings shown in serviceable and unserviceable condition. Straighten minor bends in tubing when possible. Discard entire tube assembly if fittings are damaged or tubing has been kinked.

(3) *Nozzle fuel return tubes and hoses.* Clean nozzle fuel return tubes and hoses thoroughly. Inspect tube and hose connections for cracks, or mutilated sealing surfaces. Inspect hoses for pliability or signs of deterioration.

(4) *Fuel injection pump fuel return hose.* Pressure check fuel injection pump fuel return hose to a proof pressure of 200 psi. Replace hoses that are unserviceable.

c. Assembly. Fuel injection pump fuel tubes and nozzle fuel return hoses will be assembled during engine assembly.

3-138. Injection Pump and Turbosupercharger Oil Hoses

a. Disassembly. The injection pump and turbosupercharger oil hoses were disassembled during disassembly of engine.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38. Inspect fuel injection pump and turbosupercharger oil hoses for cracks, frayed or chafing of the woven metal sheathing. Check hose connections for cracks or damage. Replace hose connections when hose damage is apparent.

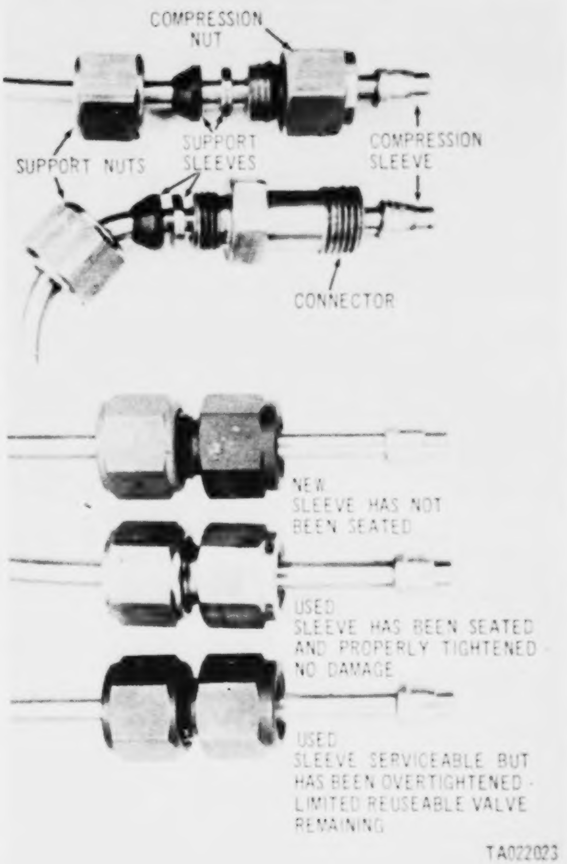

COMPRESSION NUT
SUPPORT NUTS
SUPPORT SLEEVES
COMPRESSION SLEEVE
CONNECTOR
NEW
SLEEVE HAS NOT BEEN SEATED
USED
SLEEVE HAS BEEN SEATED AND PROPERLY TIGHTENED - NO DAMAGE
USED
SLEEVE SERVICEABLE BUT HAS BEEN OVERTIGHTENED - LIMITED REUSEABLE VALVE REMAINING
TA022023

Figure 3-285. Comparison of serviceable sleeves – injector nozzle tube ends.

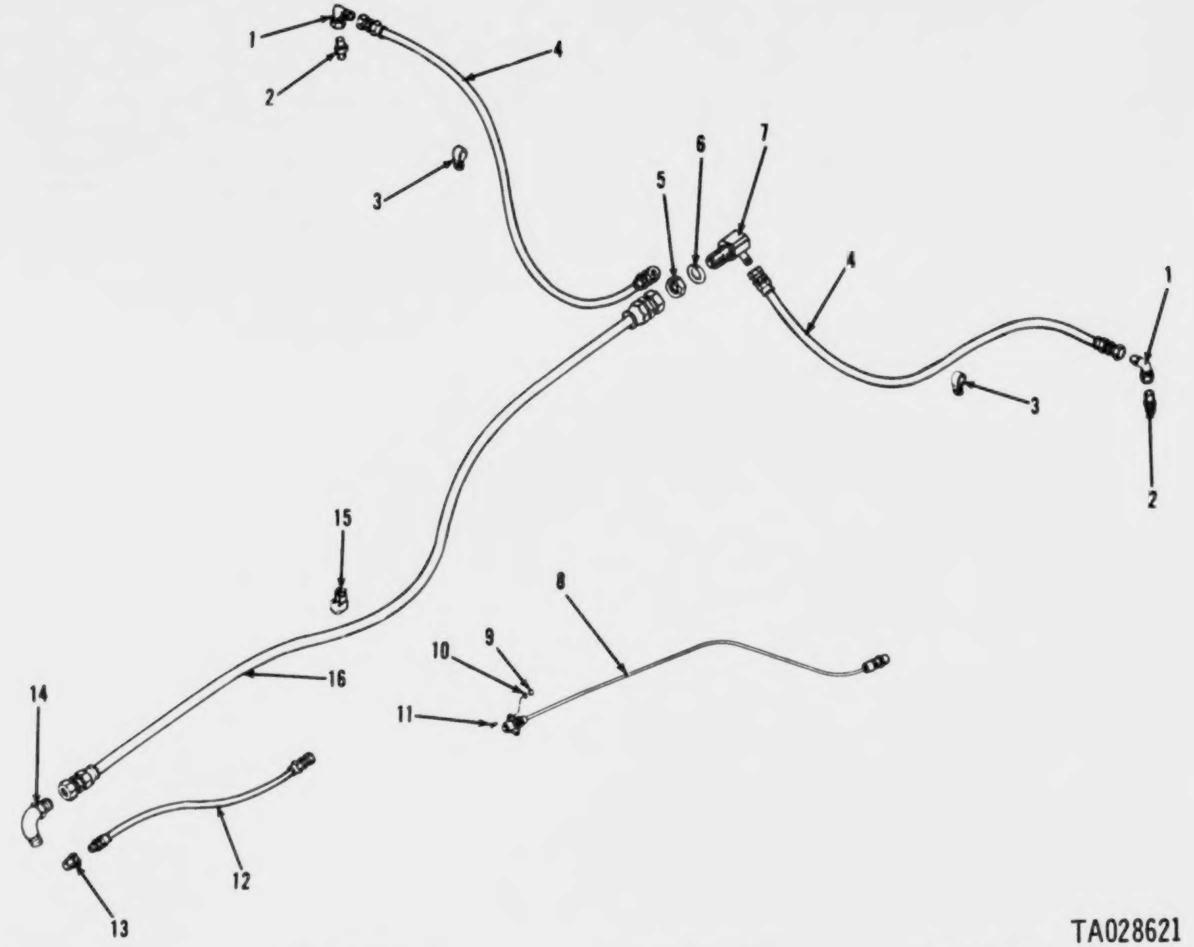
c. Assembly. Injection pump and turbosupercharger oil hoses will be assembled during engine assembly.

3-139. Generator Oil Lines and Associated Parts — Model AVDS-1790-2C Engine

a. Disassembly. The generator oil lines and associated parts were disassembled during disassembly of engine.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38. Inspect generator oil hoses for cracks, frayed or chafing of the woven metal sheathing. Check hose connections for cracks or damage. Check fittings and connections for damaged threads, nicks and scratches. Replace unserviceable parts.

c. Assembly. Generator oil lines will be assembled during engine assembly.



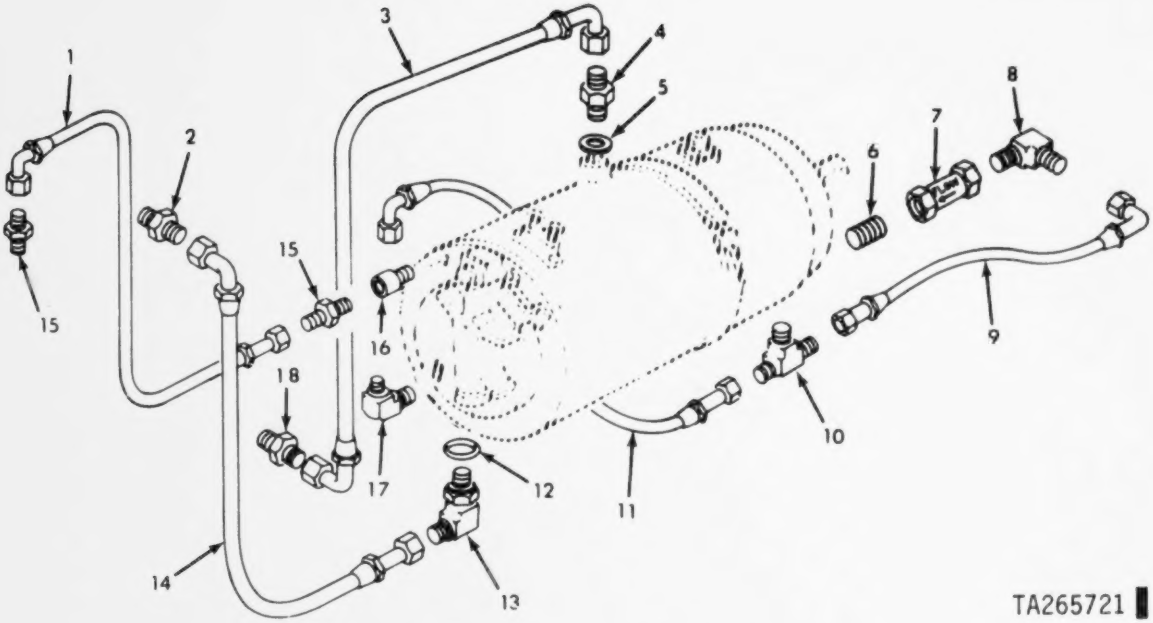
1 Tube elbow	5 Plain hexagon nut	9 Self-locking nut	13 Pipe bushing
2 Straight adapter	6 Flat washer	10 Flat washer	14 Elbow
3 Loop clamp	7 Multiple connector	11 Machine screw	15 Loop clamp
4 Hose assembly	8 Injection pump electrical lead	12 Tube assembly	16 Hose assembly

Figure 3-286. Injection pump and turbosupercharger oil hoses – Exploded View.

3-140. Generator Air Intake and Exhaust Tubes and Associated Parts. Model AVDS-1790-2D and AVDS-1790-2DR Engines

a. Disassembly.

(1) Loosen two hose clamps (1 and 14, fig. 3-288)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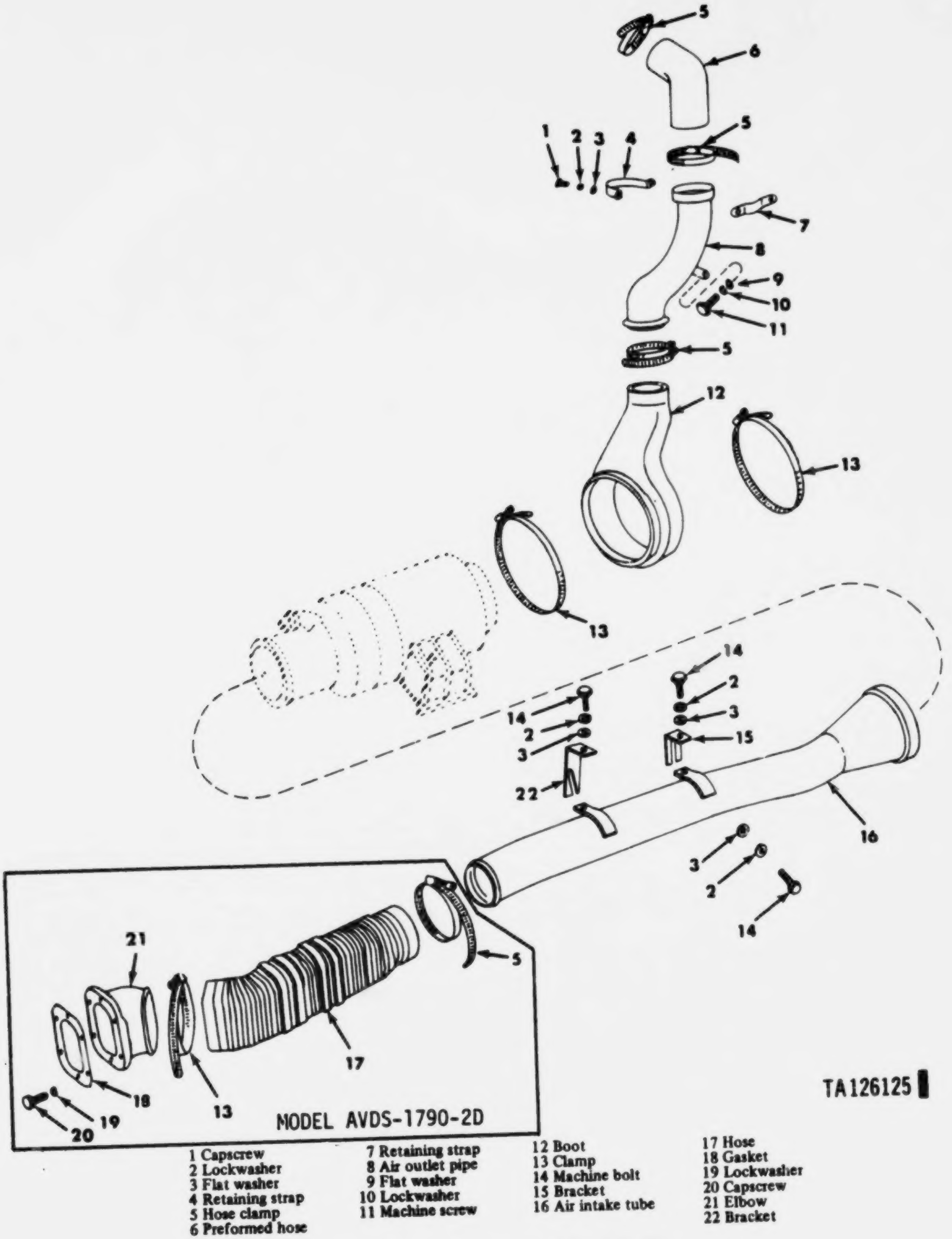
TA265721

1 Hose assembly
2 Straight adapter
3 Hose assembly
4 Straight adapter
5 Preformed packing
6 Nipple
7 Check valve
8 Elbow
9 Hose assembly
10 Tee
11 Hose assembly
12 Preformed packing
13 Elbow
14 Hose assembly
15 Straight adapter
16 Coupling
17 Elbow
18 Straight adapter

Figure 3-287. Generator oil hoses and associated parts–exploded view, model AVDS-1790-2C engine.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MODEL AVDS-1790-2D
TA126125

1 Capscrew
2 Lockwasher
3 Flat washer
4 Retaining strap
5 Hose clamp
6 Preformed hose
7 Retaining strap
8 Air outlet pipe
9 Flat washer
10 Lockwasher
11 Machine screw
12 Boot
13 Clamp
14 Machine bolt
15 Bracket
16 Air intake tube
17 Hose
18 Gasket
19 Lockwasher
20 Capscrew
21 Elbow
22 Bracket

Figure 3-288. Generator air ducting and associated parts—exploded view, Model AVDS-1790-2D and AVDS-1790-2DR engines.

and remove hose (13) from generator air intake tube (12) and elbow (15) (Model AVDS-1790-2D only). Remove clamps from hose.

(2) The generator boot (7) exhaust tube (3) and associated parts were disassembled during disassembly of the engine.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36, 3-37, 3-38.

c. Assembly.

(1) The generator boot (8, fig. 3-288) exhaust tube (3) and associated parts will be assembled during engine assembly.

(2) Install two hose clamps (1 and 14) on hose (13). Install hose on elbow (15) and on air intake tube (12) and tighten hose clamps (model AVDS-1790-2D only).

Section XXIV. REPAIR OF CRANKCASE BREATHER TUBES, FIRE EXTINGUISHER TUBE, INJECTION PUMP ELECTRICAL LEAD, MANIFOLD HEATER FUEL TUBES, AND OIL COOLER VENT LINE, FILTER AND ELECTRICAL COMPONENTS

3-141. General

This section covers the repair of the crankcase breather tubes, fire extinguisher tube, injection pump electrical lead, manifold heater fuel tubes, filter and electrical components, and oil cooler vent lines. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair operations.

3-142. Crankcase Breather Tubes, Fire Extinguisher Tube, and Electrical Lead

a. Disassembly. The crankcase breather tubes, fire extinguisher tube, electrical, and oil cooler vent lines were disassembled during engine disassembly.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38.

(1) *Breather tubes and tee.* Inspect breather tubes (4 and 14, fig. 3-289) and breather tube tee (16) for cracked, bent, or dented condition and for warping of tube mounting surface. Replace when cracked, badly dented or bent, or when mounting surfaces are badly warped. Straighten bent tubes to as near original shape as possible. Remove minor warpage of mounting surfaces by rubbing across abrasive cloth held tightly on a surface plate or similar flat surface.

(2) *Fire extinguisher tube.* Inspect fire extinguisher tube (22) for cracked, bent, or dented condition. Check spray holes in tube for obstructions and corrosion. Inspect tube fittings (23 and 24) for cracks and for stripped or damaged threads. Replace tube when cracked, badly bent, or when spray holes cannot be cleaned. Replace fittings when cracked or when threads are damaged.

(3) *Pump electrical lead.* Inspect pump electrical lead (8, fig. 3-286) for cracked, frayed, or deteriorated insulation. Inspect lead for continuity with a low voltage circuit tester. Inspect electrical lead when insulation is cracked or broken, connector threads are damaged, or when low voltage tester indicates a failure.

(4) *Oil cooler vent lines.* Inspect vent lines (2, 5, and 6, fig. 3-290) for frayed covering and damaged threads. Inspect fittings (1) and elbow for cracks and thread damage. Replace damaged parts.

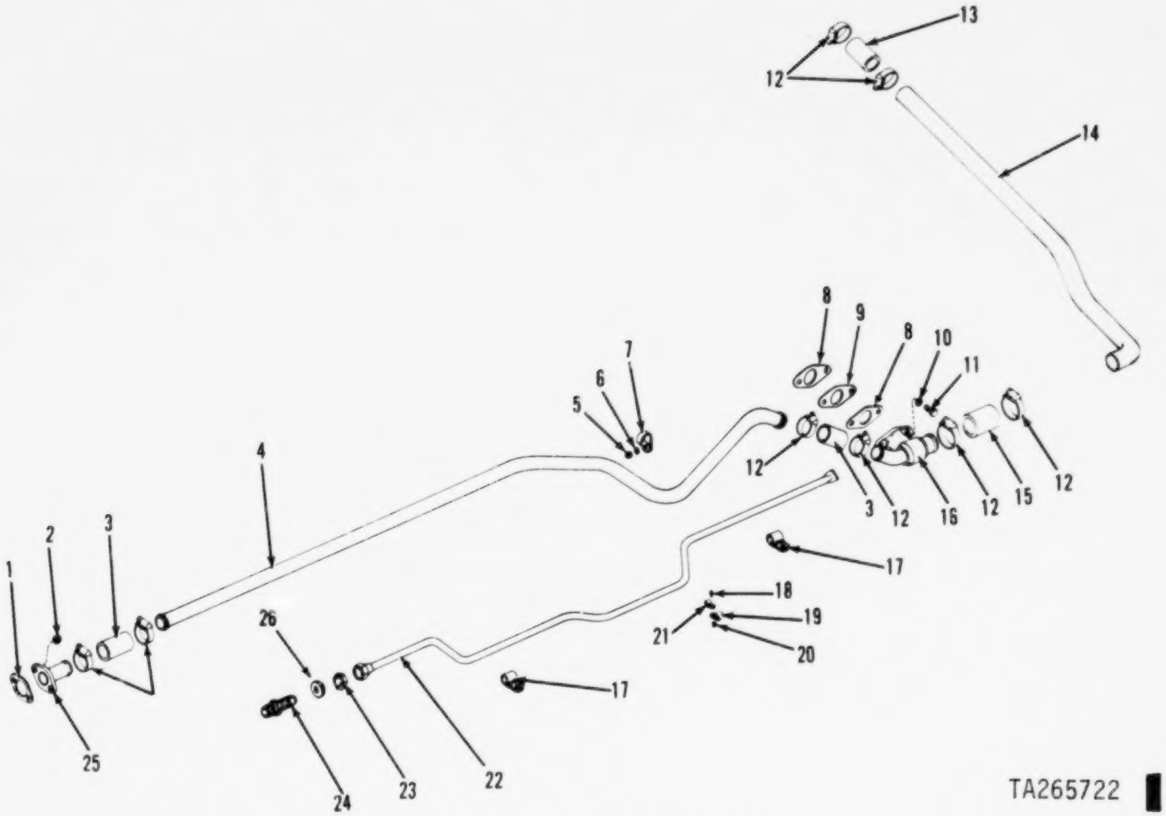
c. Assembly. The crankcase breather tubes, fire extinguisher tube, electrical lead, and oil cooler vent lines are assembled during engine assembly.

3-143. Manifold Heater Tubes, Filter, and Electrical Components

a. Disassembly. The heater tubes and electrical components were disassembled during engine disassembly.

(1) Remove tube tee (36, fig. 3-268) and elbow (36, fig. 3-267). Remove four assembled washer bolts (31) and four flat washers (32) attaching solenoid valve (37) to mounting bracket (33) and solenoid mounting bracket to filter mounting bracket. Remove solenoid mounting bracket. Remove two screws (15, fig. 3-282), lockwashers (16) and flat washers (14) and remove solenoid valve (37, fig. 3-267) and fuel filter as a unit. Separate fuel filter and solenoid valve (13, fig. 3-282). Remove connecting nipple (38, fig. 3-267) and inlet tube connector (30).

(2) Remove tube tee (24, fig. 3-268), elbow (23), check valve (25), nipple (19), elbows (20 and 16) and coupling (22) from solenoid valve (21). Remove two assembled washer bolts (29) and flat washer (28)



1	Crankcase breather tube gasket
2	Self-locking nut
3	Air duct hose
4	Tube
5	Self-locking nut
6	Flat washer
7	Loop clamp
8	Crankcase breather tube gasket
9	Restrictor plate
10	Lockwasher
11	Capscrew
12	Hose clamp
13	Non-metallic hose
14	Bent tube
15	Air duct hose
16	Crankcase breather tee
17	Loop clamp
18	Machine screw
19	Loop clamps
20	Self-locking nut
21	Loop clamp
22	Tube assembly
23	Plain nut
24	Straight adapter
25	Straight adapter
26	Lockwasher

Figure 3-289. Crankcase breather tube and fire extinguisher tube – exploded view.

and remove solenoid valve from mounting bracket (27).

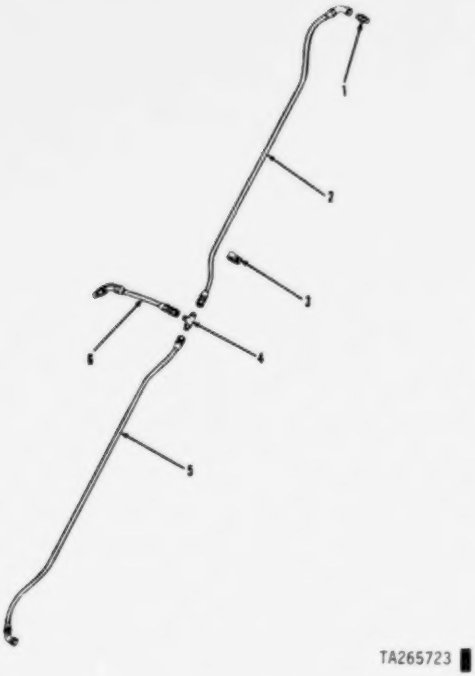
(3) Unscrew and separate filter head (14, fig. 3-280) and filter bowl (17). Remove filter element (15). Remove and discard preformed packing (16).

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38.

(1) *Heater tubes.* Flush rigid heater tubes (10, fig. 3-267 and 38, fig. 3-268) thoroughly and dry with compressed air. Clean plastic tubes (5, fig. 3-267 and 30, fig. 3-268) with a clean dry cloth and blow tubes out with filtered compressed air. Inspect tube fittings for stripped or damaged threads. Inspect tubes for internal diameter reduction at tube nut ferrule. Replace tubes that are split or kinked or when fittings are damaged, or ends are crushed. Replace tubes when internal diameter is reduced enough to restrict fuel flow.

(2) *Heater fuel filter.* Replace filter element if deformed or if embedded with foreign material.

(3) *Electrical components.* Inspect heater electrical leads (21, fig. 3-267 and 37, fig. 3-268) and ignition units (22, fig. 3-267 and 36, fig. 3-268) for cracks, continuity, and other damage. Replace leads and ignition units that fail to pass continuity test.



1 Straight adapter
2 Vent line
3 Loop clamp
4 Tube tee
5 Vent line
6 Vent line

Figure 3-290. Oil cooler vent lines – exploded view.

(4) *Solenoid valves.* Plug valve inlet and outlet openings to prevent entrance of foreign material. Clean the solenoid valves with a cloth moistened with dry-cleaning solvent. The valves contain rubber parts and should not be immersed in solvent. Inspect the solenoid valves for cracks and dents. Install suitable fittings, actuate solenoid valve with 24 volt dc current, and pump fuel through the valve. When fuel flows freely, valve is functioning normally. Restricted fuel flow indicates a faulty electrical circuit or improper torque setting of acorn nut. Loosen acorn nut and torque tighten nut to 50 pound inches. Recheck solenoid operation. If valve is still inoperative, replace valve.

c. Assembly.

(1) Install new preformed packing (16, fig. 3-280) on filter bowl (17). Install filter element (15) in bowl (17) and install filter head (14) on bowl.

(2) Position heater fuel return solenoid valve (21, fig. 3-268) on mounting bracket (27) and install two assembled washer bolts (29) and flat washer (28) securing solenoid valve to bracket. Install coupling (22), elbow (23) and tee (24) in inlet side of the solenoid valve. Install elbow (20), nipple (19), fuel check valve (25) and elbow (16) in the outlet side of the solenoid valve.

NOTE

Arrow on check valve indicates the direction of fuel flow.

(3) Install inlet tube connector (30, fig. 3-267) in manifold heater fuel filter. Install connecting nipple (38) between fuel filter and manifold heater fuel solenoid valve (37). Position fuel filter with solenoid valve on filter bracket (12, fig. 3-282) and install two screws (15), lockwashers (16) and flat washers (14) securing filter to bracket. Position solenoid mounting bracket (33, fig. 3-267) and install four assembled washer bolts (31) and four flat washers (32) securing solenoid bracket (33) to filter mounting bracket and solenoid valve (37). Install elbow (36) and tube tee (36, fig. 3-268).

NOTE

Solenoid valves can be adapted to fit different applications on the engine. Orientation of bottom unit with respect to top unit can be changed through 360 degrees by loosening the acorn nut at the bottom of the valve. Torque tighten acorn nut to 50 pound-inches after positioning.

Section XXV. REPAIR OF FUEL INJECTION PUMP DRIVE COUPLING, FUEL INJECTOR NOZZLES, PISTON OILER NOZZLES, TIME TOTALIZING METER, AND STARTER LOW VOLTAGE PROTECTIVE MODULE

3-144. General

This section covers the repair of the fuel injection pump drive coupling, fuel injector nozzles, piston oiler nozzles, and time totalizing meter. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair instructions.

3-145. Fuel Injection Drive Coupling

a. Disassembly.

(1) Refer to figures 2-45 and 2-46 to remove front coupling sleeve and hub from injection pump.

(2) Separate front coupling sleeve (18, fig. 3-232) and injection pump hub (10). Remove ring (16) from coupling sleeve and remove woodruff key (2) from pump shaft.

NOTE

Keep front coupling sleeve and hub together. Place them with the rear coupling sleeve and drive shaft hub on rear fan drive housing. Check identification marks made during engine disassembly (fig. 2-43) to make sure these parts match. The parts are mated and must be kept together.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38. Inspect the front and rear coupling sleeves and hubs for wear and mutilation and for fit with the splines of mating parts. Mating splines must match without binding and with a maximum total backlash of 0.006 inch from input end through the output end. Check the rings (16) and (9, fig. 3-232) for cracked or torn condition and for deterioration.

c. Assembly.

(1) Install woodruff key (2, fig. 3-232) in pump shaft. Install ring (16) in internal groove of front coupling sleeve (18).

(2) Install injection pump hub (15) in coupling sleeve. Refer to figure 2-45 to install hub and sleeve on pump shaft and install preformed packing.

3-146. Fuel Injector Nozzle and Holder Assembly

Refer to paragraph 2-48*b* through 2-48*g* and figure 2-133 for repair of the fuel injector nozzle and holder assembly.

3-147. Piston Oiler Nozzle Assembly

a. Disassembly. Do not remove nozzles (fig. 3-291) unless the nozzle or holder cannot be cleaned without disassembly. To remove nozzles, position holder in a soft-jawed vise and remove nozzles.

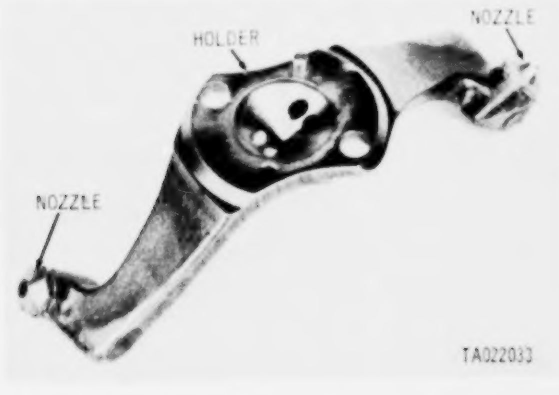


Figure 3-291. Piston oiler nozzle and holder assembly.

b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38. Make sure oil passages in holder and oil holes in nozzles are clean and free of obstruction. Replace nozzle and holder as necessary, when oil passages and oil holes cannot be cleared of obstructions.

c. Assembly. Refer to figure 3-291 to install the nozzle in the holder if removed at disassembly. Stake nozzles on three flats, 120 degrees apart.

3-148. Time Totalizing Meter

a. Inspection. Inspect the time totalizing meter for dents or other deformities which would impair its function.

b. Test. Test the totalizing meter to be sure it is functioning properly by connecting the meter electrical connection (fig. 3-292) to a 24 volt electrical system. The time totalizing meter is calibrated to record the electrical impulse in tenths of an hour and will numerically record every six minutes. Allow sufficient passage of time to be certain hour counter is performing properly.

NOTE

The time registered to test the time totalizing meter should be recorded on the engine build record.

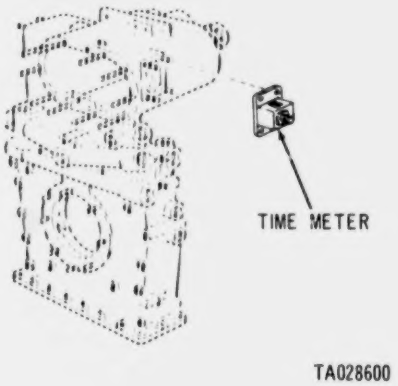


Figure 3-292. Engine time meter – exploded view.

3-148.1. Starter Low Voltage Protective Module

a. Inspection. Inspect the low voltage protective module for damaged electrical connector threads, dents or other deformities that would impair its function.

b. Function Test. Test the low voltage protective module function as follows:

(1) Connect the positive (+) lead of a variable zero to 24-vdc power supply to pin A of the module. Connect the negative (-) lead to the module case.

(2) Set the output of the power supply at 10 vdc. Using an ohmmeter, check for continuity between pins B and D. The meter should show an open circuit.

(3) Gradually increase the voltage while continuing to check for continuity between pins B and D. Continuity should be achieved at 12.25 (±.50) vdc and maintained to 24 vdc.

(4) Reduce the voltage to 15 vdc. Connect an additional positive (+) lead from the power supply to pin C of the module. Gradually increase the voltage while continuing to check the continuity between pins B and D. Continuity between pins B and D should be interrupted at 17 (±1.0) vdc and remain open to 24 volts.

(5) Reduce the voltage to 15 vdc and the continuity between pins B and D should remain open. Turn the power supply off for one second or longer. When the power supply is turned on, continuity should again be achieved between pins B and D.

(6) Modules that do not function as in (2) through (5) above must be replaced.

Section XXV.1. REPAIR OF SMOKE GENERATING SYSTEM COMPONENTS

3-148.2. General

This section covers the repair of the smoke generating system components. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair instructions.

3-148.3. Fuel Shut-off Valve

a. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38.

b. Inspection Remove elbow. Inspect valve (6, fig. 3-292.1) for free valve action. Valve must turn freely. Valve must not leak when in the closed position.

3-148.4. Solenoid Valves

a. Disassembly Remove four assembled washer bolts (22, fig. 3-292.1) and flat washers (23) and separate solenoid valves (19) from solenoid bracket (25). Remove pipe nipple (20) from solenoid valves.

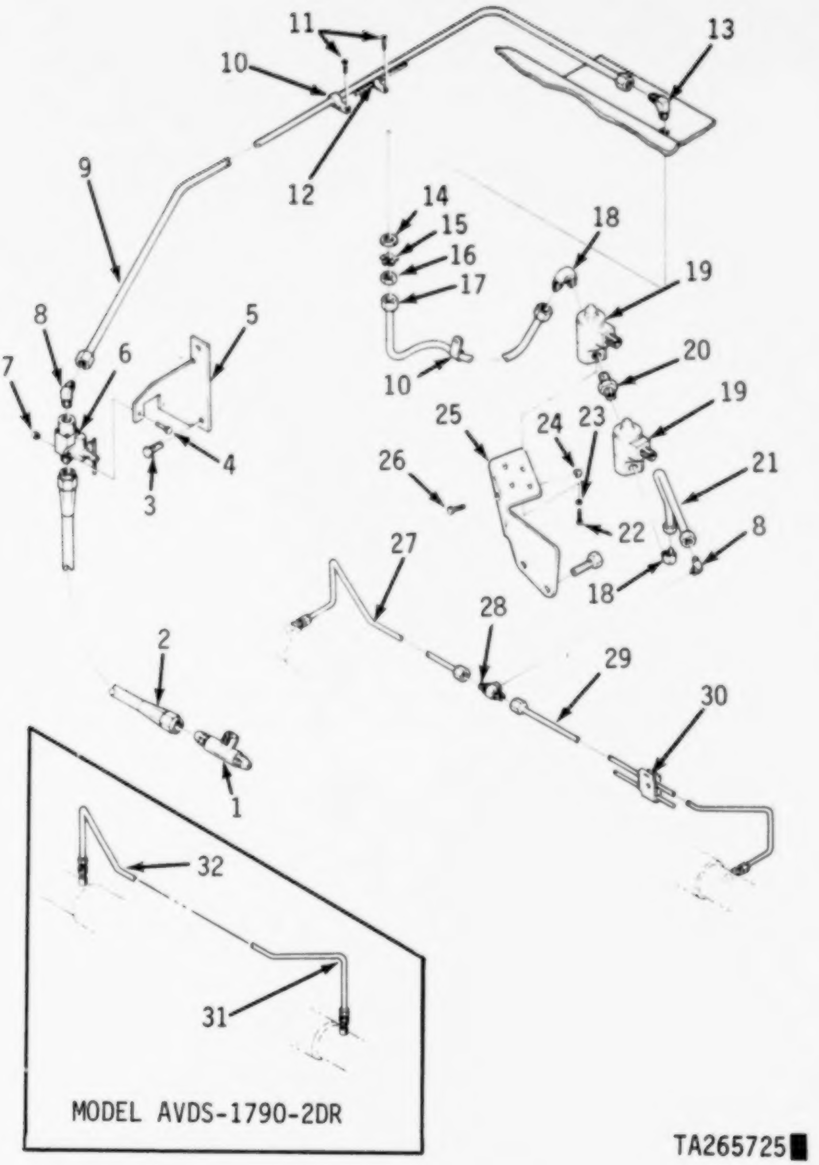
b. Cleaning, Inspection, and Repair. Refer to paragraphs 3-36 through 3-38. Connect valve(s) to 24-volt power supply source and check for an audible click when valve opens and closes. Valve must not leak when in the closed position.

c. Assembly. Install pipe nipple (20, fig. 3-292.1) in inlet port of one solenoid valve and in the outlet port of the other solenoid valve. The bottom surfaces of solenoid valves must be parallel (check on a flat surface). Install solenoid valves (19) on bracket (25), and secure with four flat washers (23) and assembled washer bolts (22). Install fuel inlet and outlet elbows (18).

3-148.5. Metal Tube Assemblies, Hose Assemblies and Associated Fittings

a. Cleaning and Inspection. Refer to paragraphs 3-36 and 3-37.

b. Repair. Refer to paragraph 3-38.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MODEL AVDS-1790-2DR
TA265725

1 Tee
2 Hose assembly
3 Assembled washer bolt
4 Capscrew
5 Bracket
6 Valve
7 Locknut
8 Elbow 45°
9 Tube assembly
10 Loop clamp
11 Assembled washer bolt
12 Loop clamp
13 Bulkhead elbow
14 Flat washer
15 Lockwasher
16 Nut
17 Tube assembly
18 Elbow
19 Solenoid valve
20 Nipple
21 Tube assembly
22 Assembled washer bolt
23 Flat washer
24 Lock nut
25 Bracket
26 Capscrew
27 Tube assembly
28 Tee
29 Tube assembly
30 Retaining strap and clamp pad
31 Tube assembly
32 Tube assembly

Figure 3-292.1. Smoke Generating System–exploded view.

Section XXV.2. REPAIR OF OIL SAMPLING SYSTEM COMPONENTS

3-148.6. General

This section covers the repair of the oil sampling system components. Specific instructions for disassembly, cleaning, inspection, and assembly accompany the repair instructions.

3-148.7. Oil Sampling System

a. Disassembly. For complete disassembly of the oil sampling system into its components refer to paragraph 2-49.4.

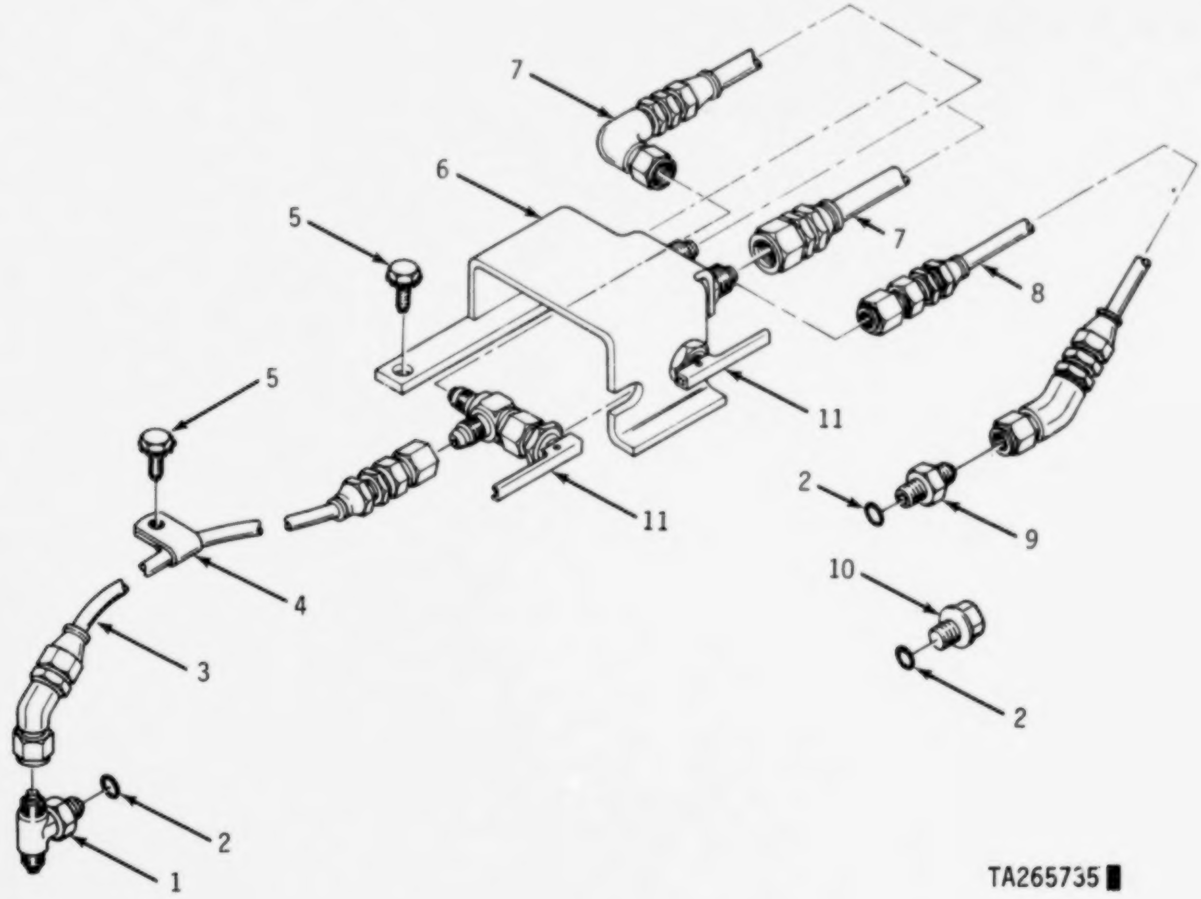
b. Cleaning, Inspection and Repair. Refer to paragraphs 3-36 through 3-38. Inspect two toggle valves (11, fig. 3-292.2) for secure activating handles. Valve must open and close freely and must not leak when in the closed position.

c. Assembly. For complete assembly of the oil sampling system refer to paragraph 2-49.4.

3-148.8. Oil Line Assemblies and Associated Fittings

a. Cleaning and Inspection. Refer to paragraph 3-36 and 3-37.

b. Repair. Refer to paragraph 3-38.



1 Tee	7 Oil sampling hose
2 Preformed packing	8 Transmission oil cooler line
3 Engine oil cooler line	9 Adapter
4 Loop clamp	10 Plug
5 Assembled washer bolt	11 Oil sampling toggle valve
6 Bracket	

Figure 3-292.2. Oil sampling system - exploded view.

Section XXVI. REPAIR OF ELECTRICAL SYSTEM WIRING HARNESS ASSEMBLY

3-149. General

The electrical system wiring harness assembly (Models AVDS-1790-2C and AVDS-1790-2D) is made up of two major circuits, the engine circuit and transmission circuit. The engine circuit includes leads for the starter, starter low voltage protection module, generator, generator blower motor (2D only), manifold heater system, engine oil pressure and oil temperature transmitters, fuel solenoids, fuel/water separator automatic drain module and hour meter. The transmission circuit includes leads for the neutral shift switch, oil pressure and oil temperature transmitters and manifold heater solenoid.

The electrical system wiring harness assembly (Model AVDS-1790-2DR) is made up of one major circuit. The engine circuit includes leads for starter solenoid wiring harness, generator, generator blower motor, manifold heater system, oil pressure and oil temperature transmitters, fuel solenoids, fuel shutoff, governor solenoid, auxiliary generator oil pressure switch, fuel/water separator automatic drain module, hour meter and transmission oil pressure and temperature transmitters.

3-150. Disconnect Points

a. The various electrical components are interconnected by wiring harnesses, cables and leads which terminate at removable plug-in connectors and receptacles. The cables, leads and harnesses are fastened to the engine and/or transmission by means of tie wraps and loop clamps which are secured to tapped pads and brackets.

b. Wiring harness connector mounting brackets (Models AVDS-1790-2C and AVDS-1790-2D) are located at the top of engine. Wiring harness connector mounting bracket (Model AVDS-1790-2DR) is located on the left side of the transmission. The bracket location provides a means of quick disconnecting electrical circuit from the vehicle.

3-151. Circuit Designations

The circuit numbers assigned to the electrical circuits are listed in table 3-28. Each harness, cable and electrical lead has a numbered band to identify the circuit. The band number is shown at the termination of each circuit on the wiring diagrams (figs. 3-293 through 3-297.1).

Table 3-28. Circuit Numbers

Circuit No.	Circuit Name
1	Generator to engine disconnect.
2	Generator to engine disconnect.
14	Starter low voltage protection module to transmission disconnect. Transmission neutral shift switch to transmission disconnect and transmission disconnect to engine disconnect (Models AVDS-1790-2C and AVDS-1790-2D).
14	Starter low voltage protection module to engine disconnect (Model AVDS-1790-2DR).
14A	Starter low voltage protection module to starter (Models AVDS-1790-2C and AVDS-1790-2D).
26	Generator to engine disconnect (Model AVDS-1790-2DR).
33	Engine oil temperature transmitter to engine disconnect.
36	Engine oil pressure transmitter to engine disconnect.
54	Fuel shutoff to engine disconnect (Model AVDS-1790-2DR).
54A	Fuel shutoff to engine disconnect (Models AVDS-1790-2C and AVDS-1790-2D).
74	Starter solenoid to starter low voltage protection module (Model AVDS-1790-2DR).
81	Starter to engine disconnect (Models AVDS-1790-2C and AVDS-1790-2D).

82	Starter solenoid to engine disconnect (Model AVDS-1790-2DR).
321	Transmission oil pressure transmitter to transmission disconnect and transmission disconnect to engine disconnect (Models AVDS-1790-2C and AVDS-1790-2D).
321	Transmission oil pressure transmitter to engine disconnect (Model AVDS-1790-2DR).
324	Transmission oil temperature transmitter to transmission disconnect and transmission disconnect to engine disconnect (Models AVDS-1790-2C and AVDS-1790-2D).
324	Transmission oil temperature transmitter to engine disconnect (Model AVDS-1790-2DR).
415	Generator to generator blower motor (Model AVDS-1790-2D).
415	Generator blower motor to splice circuit No. 26 (Model AVDS-1790-2DR).
478	Generator to engine disconnect (Model AVDS-1790-2D and AVDS-1790-2DR).
486	Manifold pre-heaters (2) and fuel solenoid to transmission disconnect and engine disconnect. Rear fuel solenoid to transmission disconnect (Models AVDS-1790-2C and AVDS-1790-2D).
486	Manifold pre-heaters (2) and fuel solenoids (2) to engine disconnect (Model AVDS-1790-2DR).
509	Engine high oil temperature transmitter, engine low oil pressure transmitter and transmission high oil temperature transmitter to engine disconnect. (Model AVDS-1790-2DR).
509L	Engine high oil temperature transmitter and engine low oil pressure transmitter to engine disconnect. Transmission high oil temperature transmitter to transmission disconnect. Transmission disconnect to engine disconnect (Models AVDS-1790-2C and AVDS-1790-2D).
510	Dust detector pressure switches (2) to starter ground harness (Model AVDS-1790-2DR).
530/ 531	Hour meter and fuel/water separator drain module to engine disconnect (Model AVDS-1790-2C). Hour meter and fuel/water separator to starter low voltage protection module and generator (Model AVDS-1790-2D).
533	Generator to engine disconnect (Model AVDS-1790-2C).
534	Generator to engine disconnect (Model AVDS-1790-2C).
627	Governor solenoid to engine disconnect (Model AVDS-1790-2DR).
920A	Smoke generating system fuel solenoid valves to engine disconnect (Models AVDS-1790-2C and AVDS-1790-2D).
C	Auxiliary generator oil pressure switch to starter solenoid harness (Model AVDS-1790-2DR).
D	Auxiliary generator oil pressure switch to engine disconnect (Model AVDS-1790-2DR).
K	Auxiliary generator oil pressure switch to starter ground harness (Model AVDS-1790-2DR).
L	Hour meter to generator (Model AVDS-1790-2DR).
M	Engine main harness to starter solenoid harness (Model AVDS-1790-2DR).
N	Fuel/water separator drain module to splice circuit No. K (Model AVDS-1790-2DR).
T	Smoke generating solenoid valves (2) to starter ground harness (Model AVDS-1790-2DR).

3-152. Cleaning

Refer to paragraph 3-36 for cleaning instructions for electrical cables.

3-153. Inspection

Inspect the engine and transmission wiring harness assemblies, starter cables and harnesses, generator cables, blower motor harness (Model AVDS-1790-2D), smoke generating solenoid valve cable and dust detector pressure switch harness (Model AVDS-1790-2DR) for broken leads, frayed insulation and deterioration. Inspect the connectors, receptacles, clips, clamps and brackets for damage. Check individual circuits, figures 3-293 through 3-297.1, for continuity.

3-154. Wiring Harnesses and Cable Repair

a. General.

(1) Repair of harnesses and powerplant wiring is limited to replacement of faulty connectors and receptacles and to the substitution of a jumper wire for a defective harness wire. When repair is necessary, free the lead, harness or cable only insofar as necessary to effect the repair. This consists of disconnecting the connectors or receptacles at each end, and loosening or removing cable clamps or removing tie wraps, as required. Removal of the complete harness, especially in case of the longer and more complex harnesses, should be avoided.

WARNING

Some wiring harnesses and cables are hot, although MASTER BATTERY switch is in the OFF position.

(2) Disconnect the three battery ground cable assemblies prior to disconnecting any wiring harness or cable.

b. Replacement of Connectors and Receptacles. Refer to figures 3-305 through 3-307.1 for instructions concerning replacement of cable connectors, male and female plugs and receptacles.

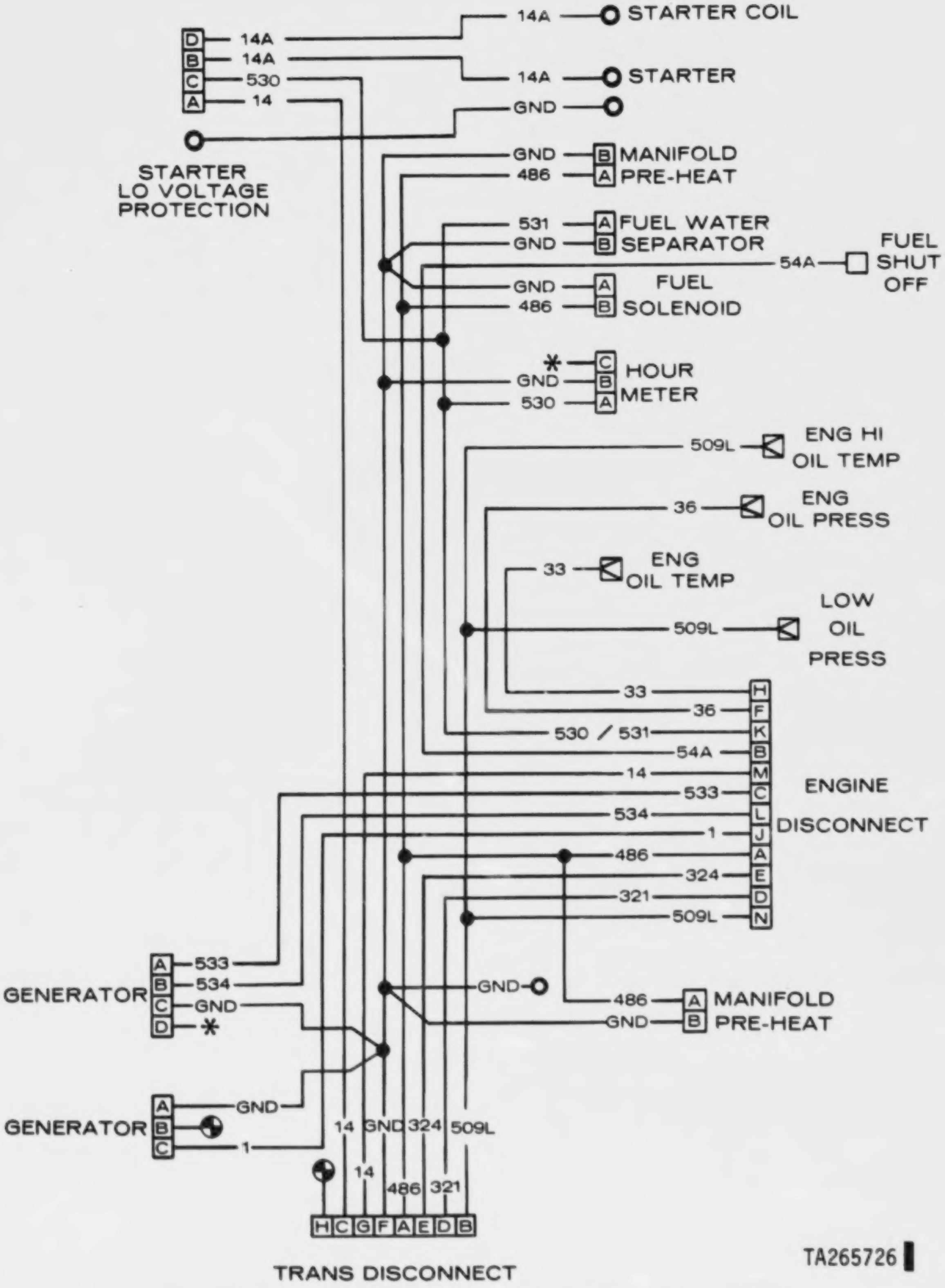
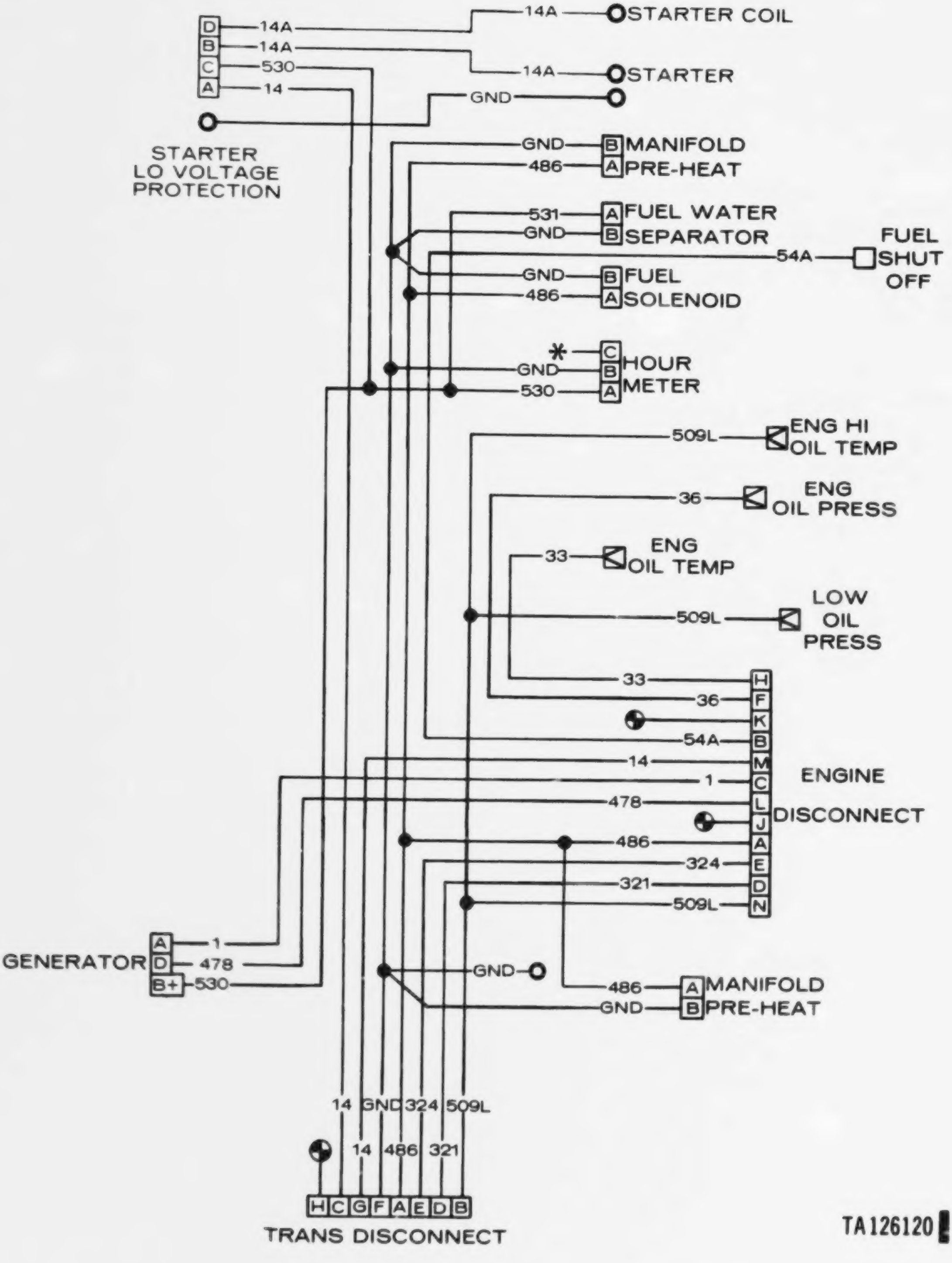
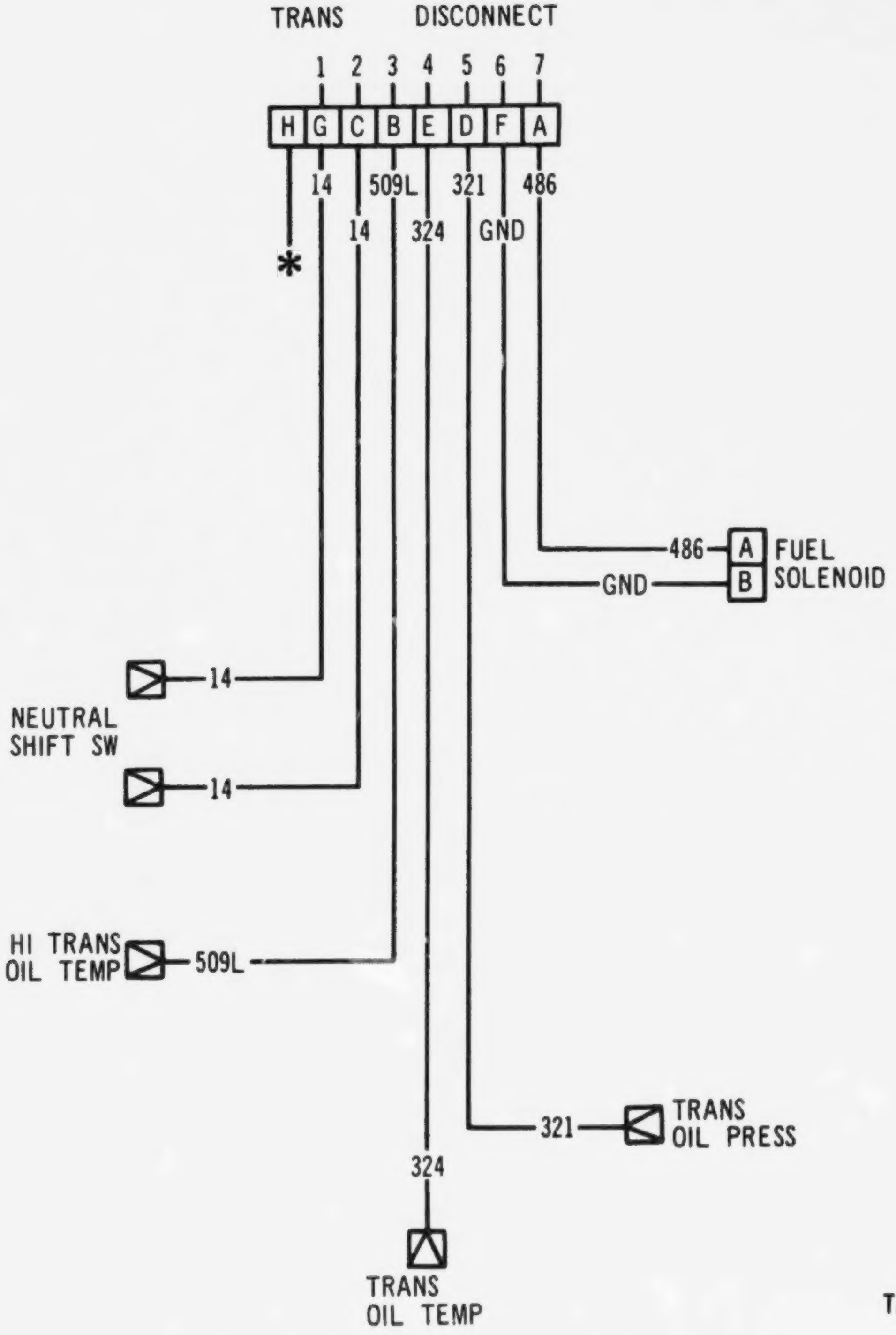

14A
STARTER COIL
D
B
C
A
14A
14A
530
14
14A
STARTER
GND
STARTER
LO VOLTAGE
PROTECTION
GND
B
MANIFOLD
486
A
PRE-HEAT
531
A
FUEL WATER
GND
B
SEPARATOR
54A
FUEL
SHUT
OFF
GND
A
FUEL
486
B
SOLENOID
*
C
GND
B
HOUR
METER
530
A
509L
ENG HI
OIL TEMP
36
ENG
OIL PRESS
33
ENG
OIL TEMP
509L
LOW
OIL
PRESS
33
H
36
F
530 / 531
K
54A
B
14
M
533
C
534
L
1
J
486
A
324
E
321
D
509L
N
ENGINE
DISCONNECT
GENERATOR
A
533
B
534
C
GND
D
*
GND
486
A
MANIFOLD
GND
B
PRE-HEAT
GENERATOR
A
GND
B
C
1
14
GND
324
509L
14
486
321
H
C
G
F
A
E
D
B
TRANS DISCONNECT
TA265726

Figure 3-293. Main engine wiring harness schematic diagram, Model AVDS-1790-2C.


14A
STARTER COIL
D
B
C
A
14A
14A
530
14
STARTER
GND
STARTER
LO VOLTAGE
PROTECTION
GND
B MANIFOLD
486
A PRE-HEAT
531
A FUEL WATER
GND
B SEPARATOR
54A
FUEL
SHUT
OFF
GND
B FUEL
486
A SOLENOID
*
C
GND
B HOUR
530
A METER
509L
ENG HI
OIL TEMP
36
ENG
OIL PRESS
33
ENG
OIL TEMP
509L
LOW
OIL
PRESS
33 H
36 F
K
54A B
14 M
1 C
478 L
J
486 A
324 E
321 D
509L N
ENGINE
DISCONNECT
GENERATOR
A 1
D 478
B+ 530
GND
486 A MANIFOLD
GND B PRE-HEAT
14
GND
324
509L
14
486
321
H C G F A E D B
TRANS DISCONNECT

TA126120

Figure 3-294. Main engine wiring harness schematic diagram, Model AVDS-1790-2D.


TRANS DISCONNECT
1
2
3
4
5
6
7
H
G
C
B
E
D
F
A
14
509L
321
486
14
324
GND
*
486
A
B
FUEL SOLENOID
GND
14
NEUTRAL SHIFT SW
14
HI TRANS OIL TEMP
509L
321
TRANS OIL PRESS
324
TRANS OIL TEMP

TA126124

Figure 3-295. Transmission wiring harness — schematic diagram.

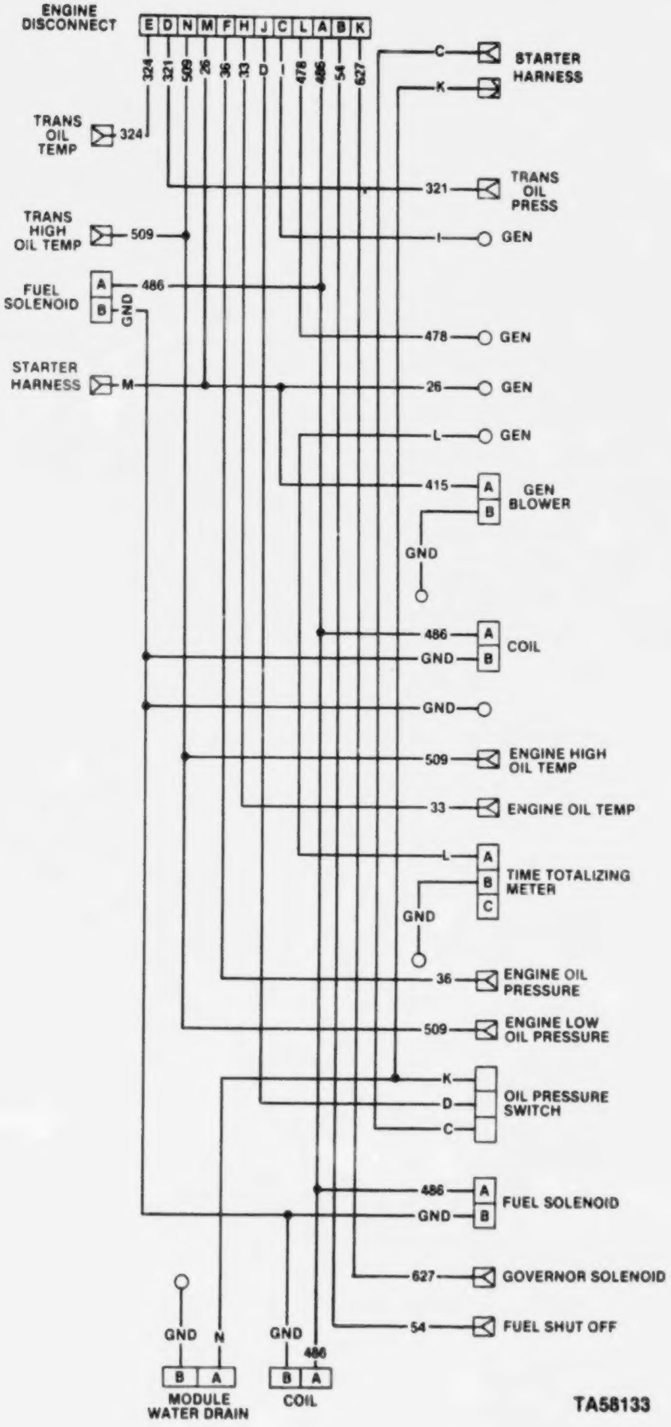

ENGINE DISCONNECT
E D N M F H J C L A B K
324 321 509 26 36 33 D I 478 486 54 627
STARTER HARNESS
C
K
TRANS OIL TEMP
324
TRANS OIL PRESS
321
TRANS HIGH OIL TEMP
509
I
GEN
FUEL SOLENOID
A
B
486
GND
478
GEN
STARTER HARNESS
M
26
GEN
L
GEN
415
A
B
GEN BLOWER
GND
486
A
GND
B
COIL
GND
509
ENGINE HIGH OIL TEMP
33
ENGINE OIL TEMP
L
A
B
C
TIME TOTALIZING METER
GND
36
ENGINE OIL PRESSURE
509
ENGINE LOW OIL PRESSURE
K
D
C
OIL PRESSURE SWITCH
486
A
GND
B
FUEL SOLENOID
627
GOVERNOR SOLENOID
54
FUEL SHUT OFF
GND
N
B
A
MODULE WATER DRAIN
GND
486
B
A
COIL
TA58133

Figure 3-295.1 Main engine wiring harness schematic diagram, Model AVDS-1790-2DR.

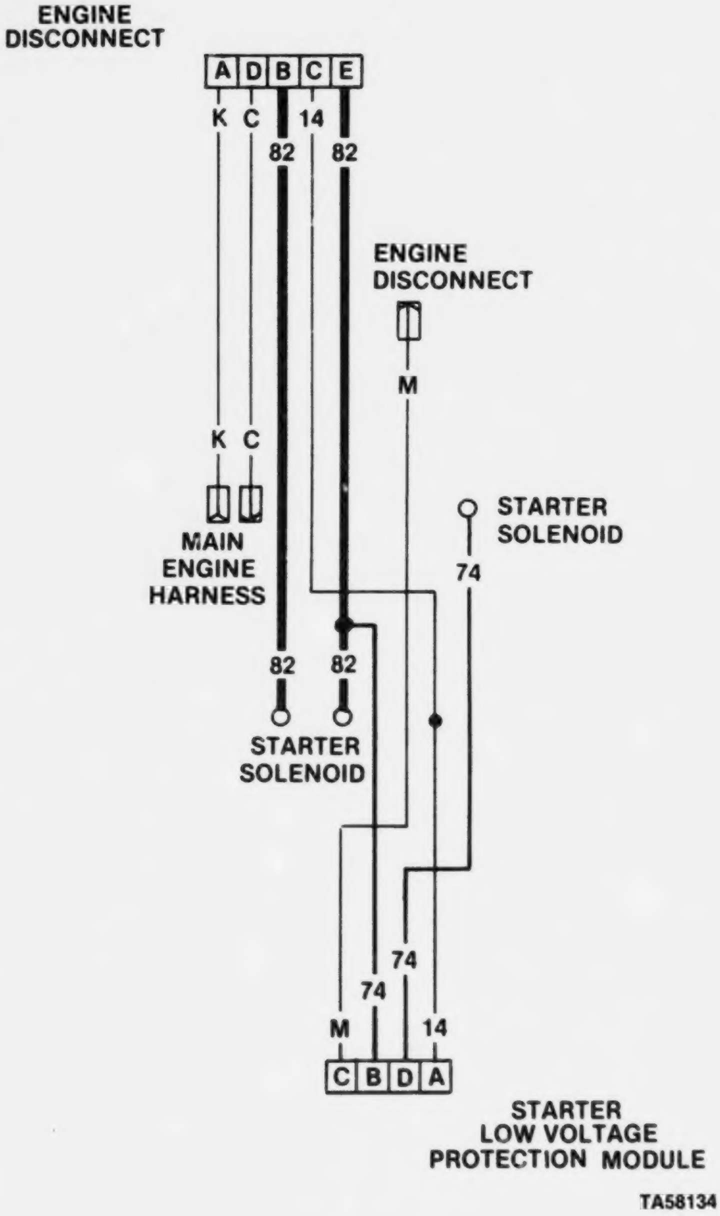
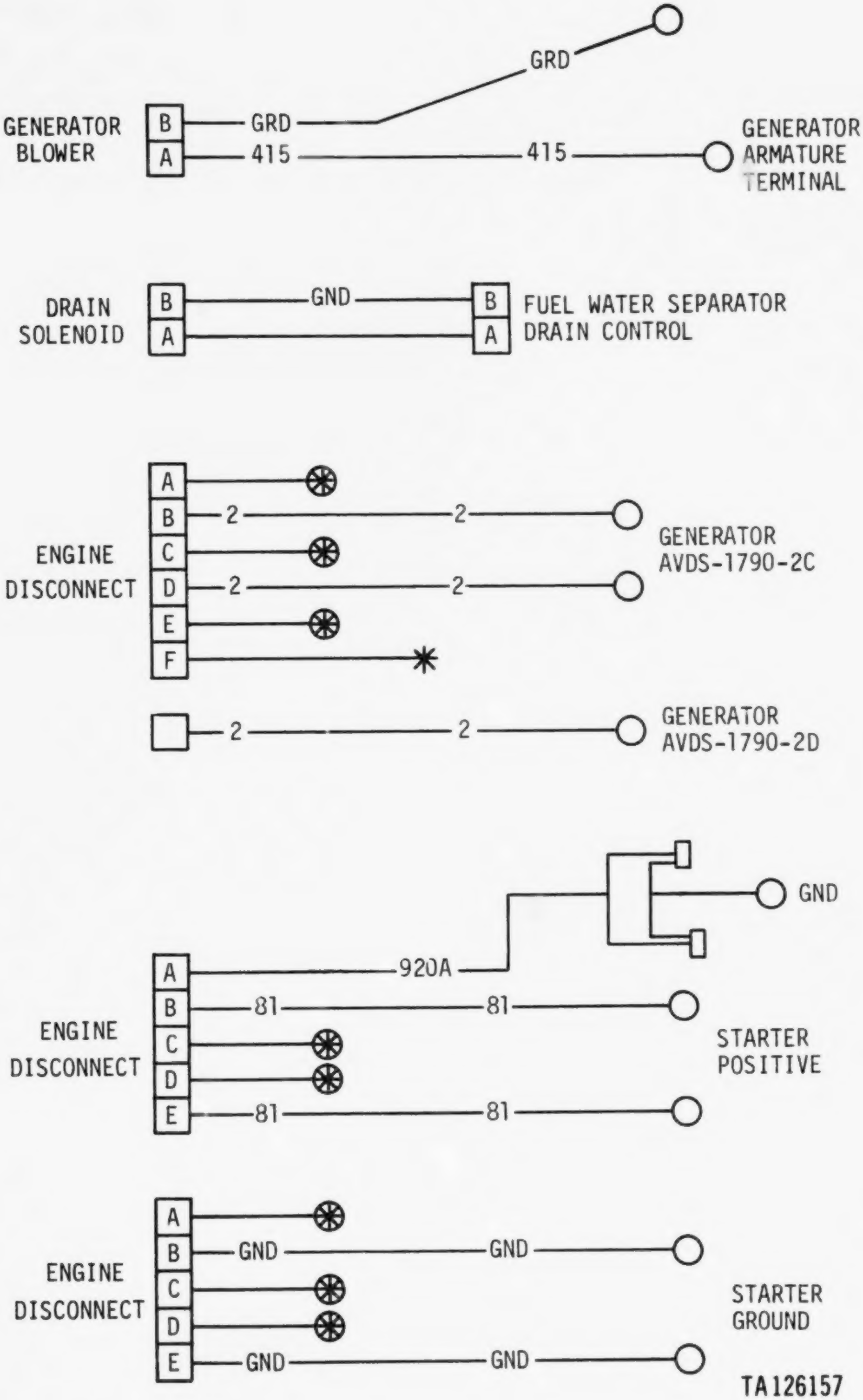
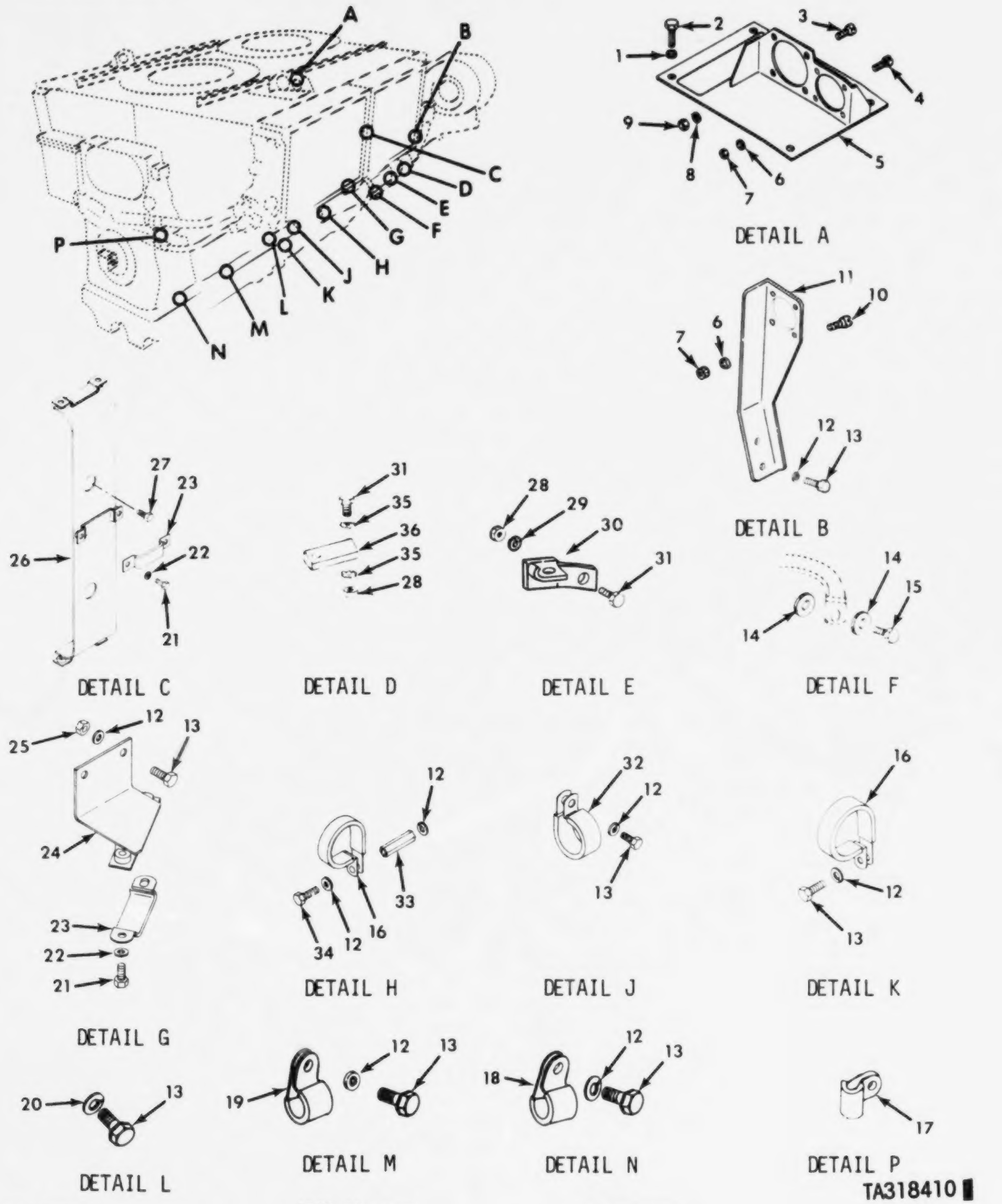

ENGINE DISCONNECT
A D B C E
K C 14
82 82
ENGINE DISCONNECT
M
K C
MAIN ENGINE HARNESS
STARTER SOLENOID
74
82 82
STARTER SOLENOID
74
74
M
14
C B D A
STARTER LOW VOLTAGE PROTECTION MODULE
TA58134

Figure 3-295.2 Starter wiring harness schematic diagram, Model AVDS-1790-2DR.


GRD
GENERATOR BLOWER
B
A
GRD
415
415
GENERATOR ARMATURE TERMINAL
DRAIN SOLENOID
B
A
GND
B
A
FUEL WATER SEPARATOR DRAIN CONTROL
ENGINE DISCONNECT
A
B
C
D
E
F
2
2
2
2
GENERATOR AVDS-1790-2C
2
2
GENERATOR AVDS-1790-2D
GND
ENGINE DISCONNECT
A
B
C
D
E
920A
81
81
81
81
STARTER POSITIVE
ENGINE DISCONNECT
A
B
C
D
E
GND
GND
GND
GND
STARTER GROUND

TA126157

Figure 3-296. Generator and starter cables, and blower motor harnesses and fuel/water separator - schematic diagram.


A
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C
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H
J
K
L
M
N
P
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
DETAIL G
DETAIL H
DETAIL J
DETAIL K
DETAIL L
DETAIL M
DETAIL N
DETAIL P
TA318410

1 Lockwasher
2 Capscrew
3 Machine screw
4 Machine screw
5 Support
6 Lockwasher
7 Plain nut
8 Lockwasher
9 Plain nut
10 Machine screw
11 Mounting bracket
12 Lockwasher
13 Machine bolt
14 Flat washer
15 Capscrew
16 Loop clamp
17 Loop clamp
18 Loop clamp
19 Loop clamp
20 Lockwasher
21 Capscrew
22 Lockwasher
23 Retaining Strap
24 Mounting bracket
25 Self-locking nut
26 Mounting bracket
27 Assembled washer bolt
28 Plain nut
29 Lockwasher
30 Bus bar
31 Capscrew
32 Loop clamp
33 Spacer
34 Machine bolt
35 Lockwasher
36 Bus bar

Figure 3-297. Engine wiring harness brackets and clamps.

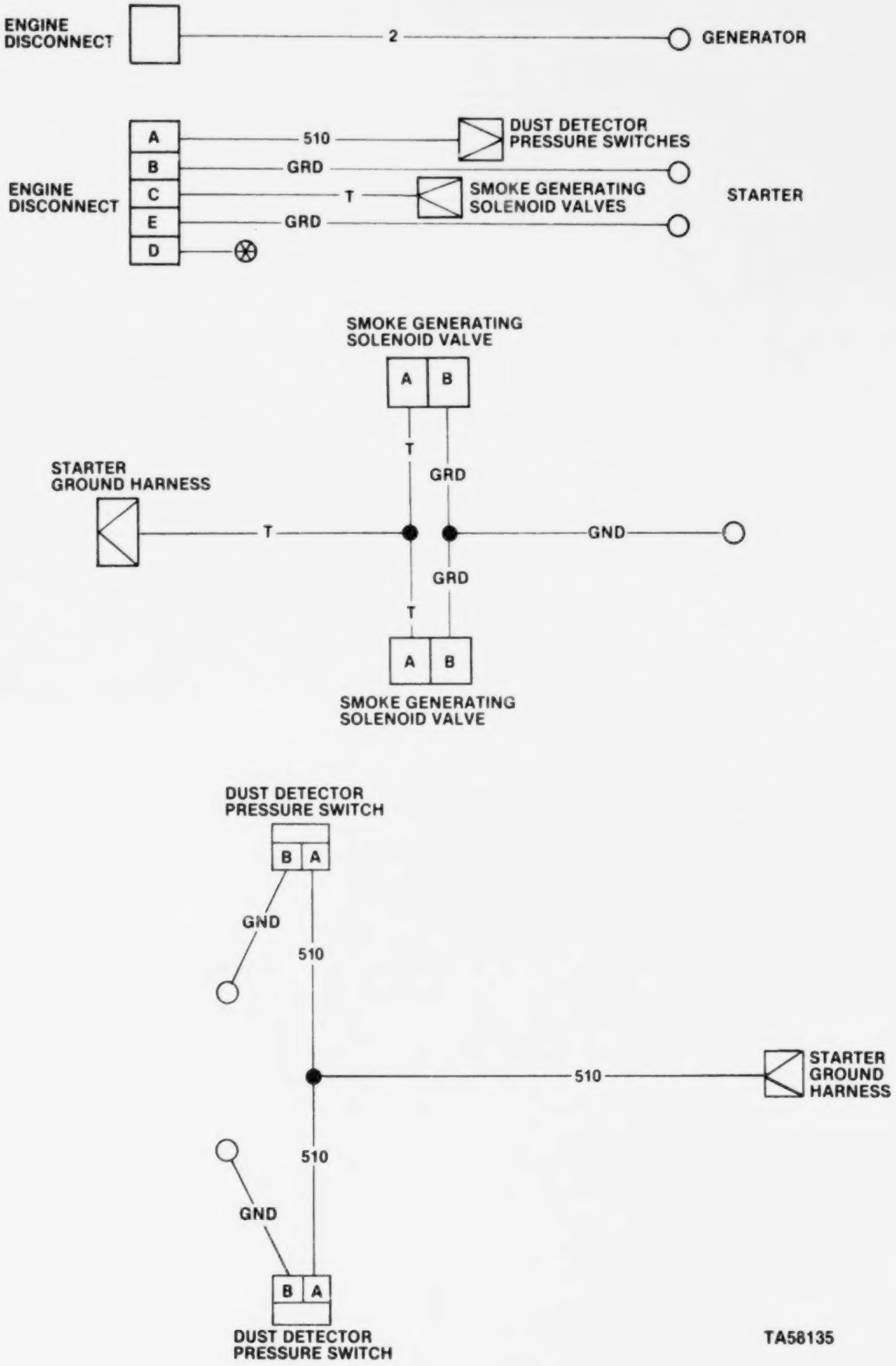
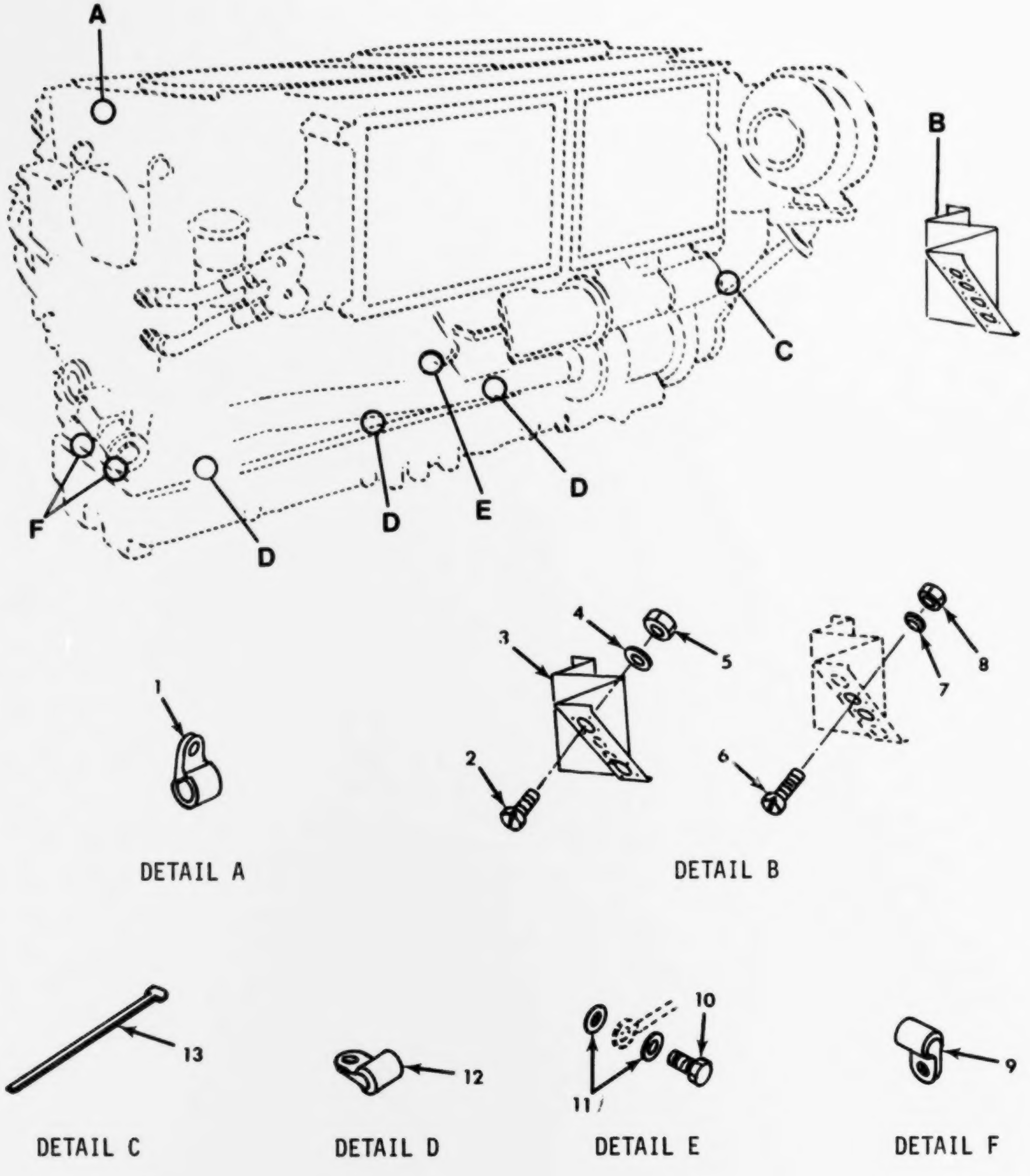

ENGINE DISCONNECT
2
GENERATOR
A
B
C
E
D
510
GRD
T
GRD
ENGINE DISCONNECT
DUST DETECTOR PRESSURE SWITCHES
SMOKE GENERATING SOLENOID VALVES
STARTER
SMOKE GENERATING SOLENOID VALVE
A
B
T
GRD
STARTER GROUND HARNESS
T
GND
GRD
T
A
B
SMOKE GENERATING SOLENOID VALVE
DUST DETECTOR PRESSURE SWITCH
B
A
GND
510
510
STARTER GROUND HARNESS
510
GND
B
A
DUST DETECTOR PRESSURE SWITCH
TA58135

Figure 3-297.1 Generator lead, starter ground harness, smoke generating solenoid valve cable and dust detector pressure switch harness - schematic diagram (Model AVDS-1790-2DR).



DETAIL A

DETAIL B

DETAIL C

DETAIL D

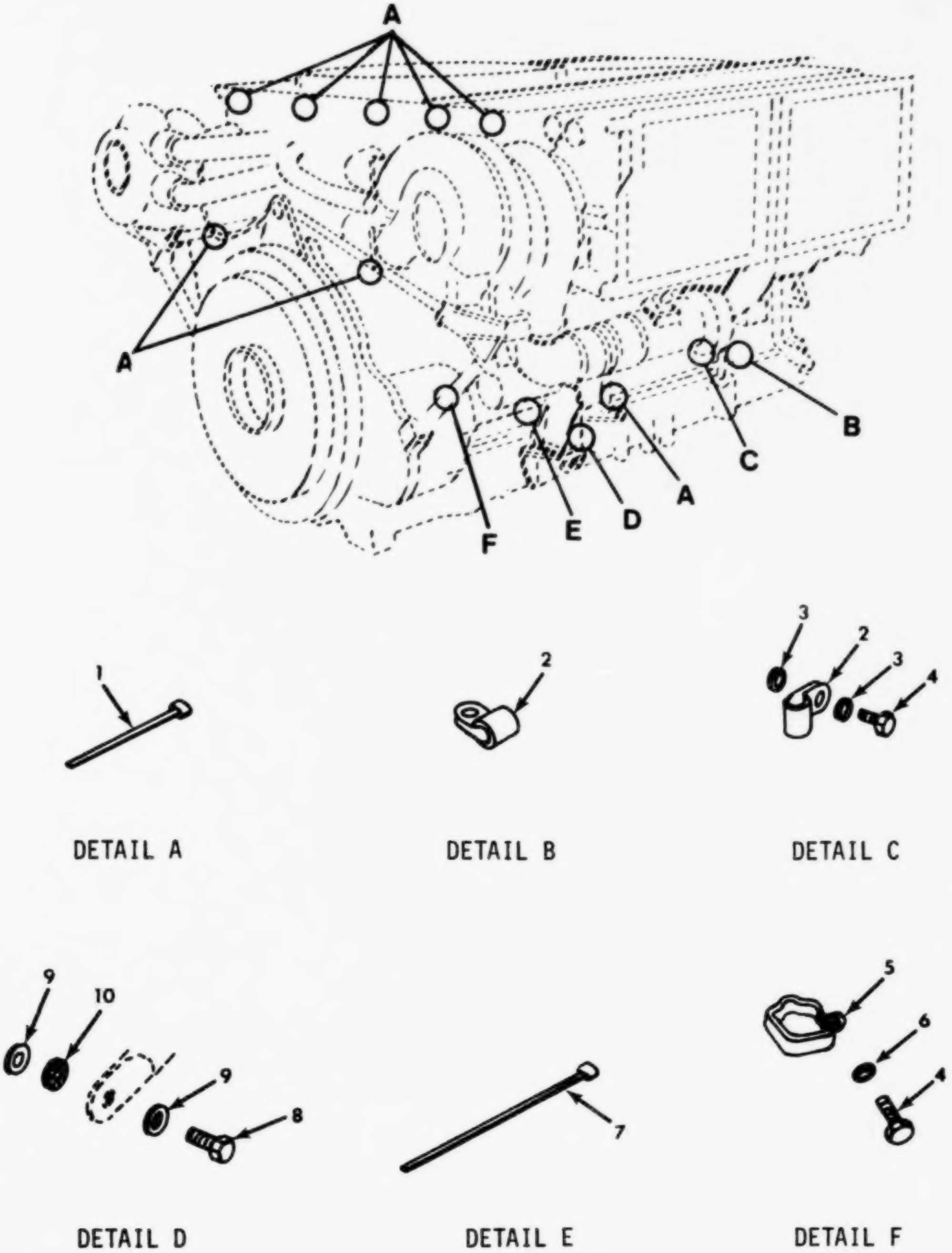
DETAIL E

DETAIL F

1 Loop clamp
2 Machine screw
3 Mounting bracket
4 Lockwasher
5 Plain nut
6 Machine screw
7 Lockwasher
8 Plain nut
9 Loop clamp
10 Machine bolt
11 Lockwasher
12 Loop clamp
13 Tiedown strap

TA58126

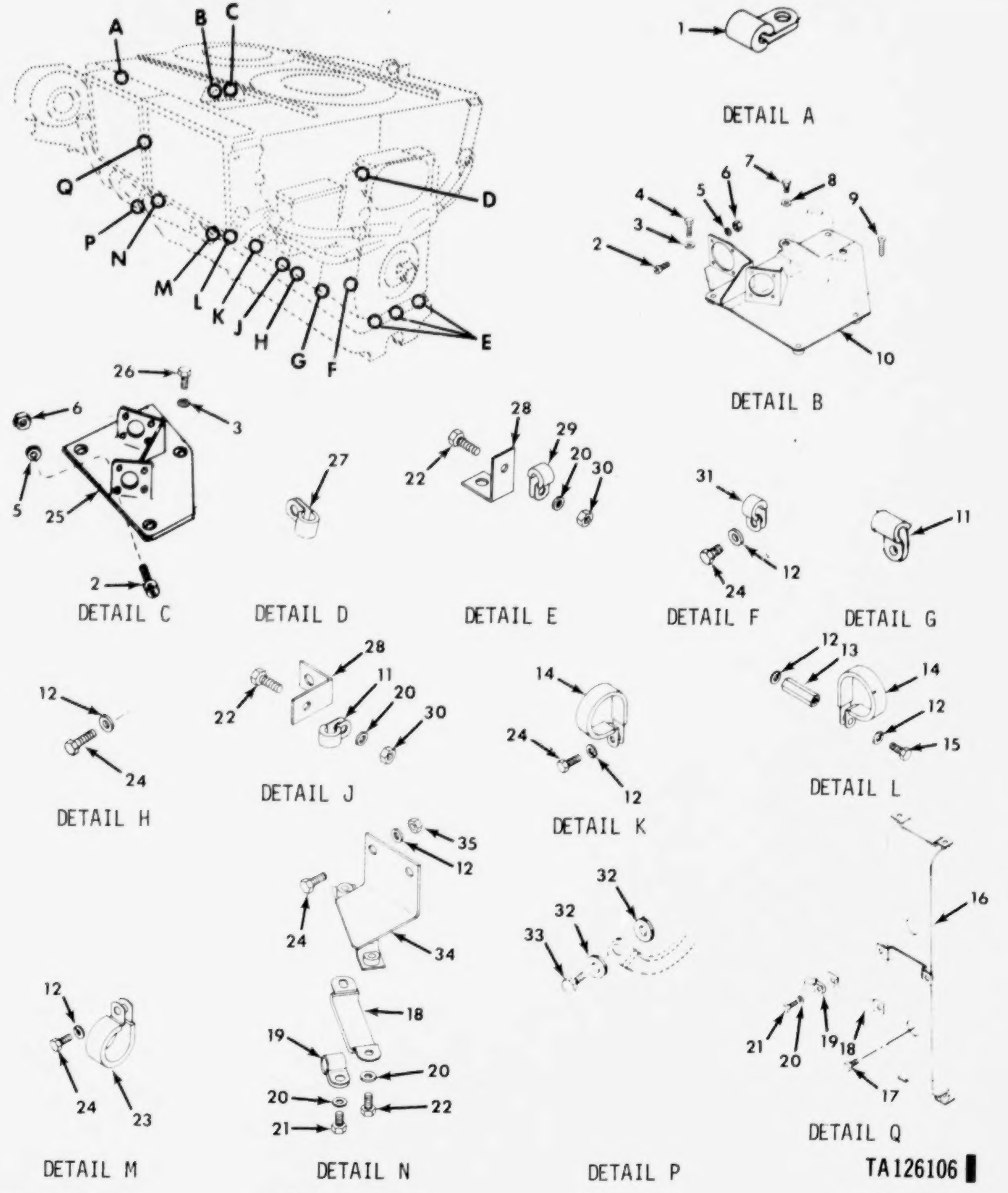
Figure 3-297.2 Engine wiring harness bracket and clamps (Model AVDS-1790-2DR).


A
A
B
C
A
F
E
D
1
DETAIL A
2
DETAIL B
3
2
3
4
DETAIL C
9
10
9
8
DETAIL D
7
DETAIL E
5
6
4
DETAIL F

1 Tiedown strap
2 Loop clamp
3 Lockwasher
4 Machine bolt
5 Loop clamp
6 Lockwasher
7 Tiedown strap
8 Capscrew
9 Flat washer
10 Lockwasher

TA58127

Figure 3-297.3 Engine wiring harness clamps (Model AVDS-1790-2DR).


A
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C
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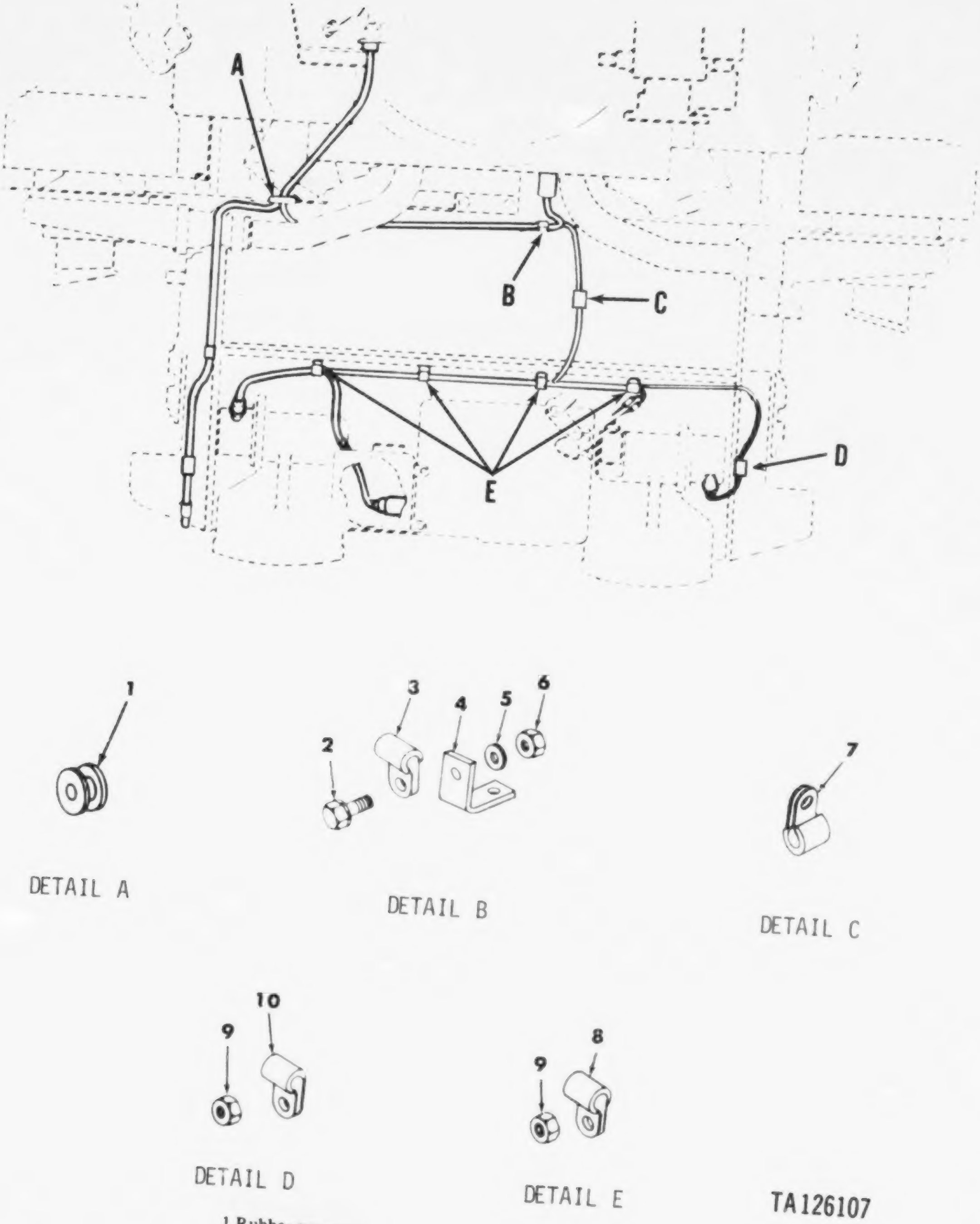
E
F
G
H
J
K
L
M
N
P
Q
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
DETAIL G
DETAIL H
DETAIL J
DETAIL K
DETAIL L
DETAIL M
DETAIL N
DETAIL P
DETAIL Q
TA126106

1 Loop clamp
2 Machine screw
3 Lockwasher
4 Machine bolt
5 Lockwasher
6 Plain nut
7 Capscrew
8 Lockwasher
9 Socket head capscrew
10 Mounting bracket
11 Loop clamp
12 Lockwasher
13 Spacer
14 Loop clamp
15 Machine bolt
16 Mounting bracket
17 Assembled washer bolt
18 Retaining strap
19 Loop clamp
20 Lockwasher
21 Capscrew
22 Capscrew
23 Loop clamp
24 Machine bolt
25 Mounting bracket
26 Capscrew
27 Loop clamp
28 Angle bracket
29 Loop clamp
30 Plain nut
31 Loop clamp
32 Flat washer
33 Capscrew
34 Mounting bracket
35 Self-locking nut

Figure 3-298. Engine wiring harness brackets and clamps.


A
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C
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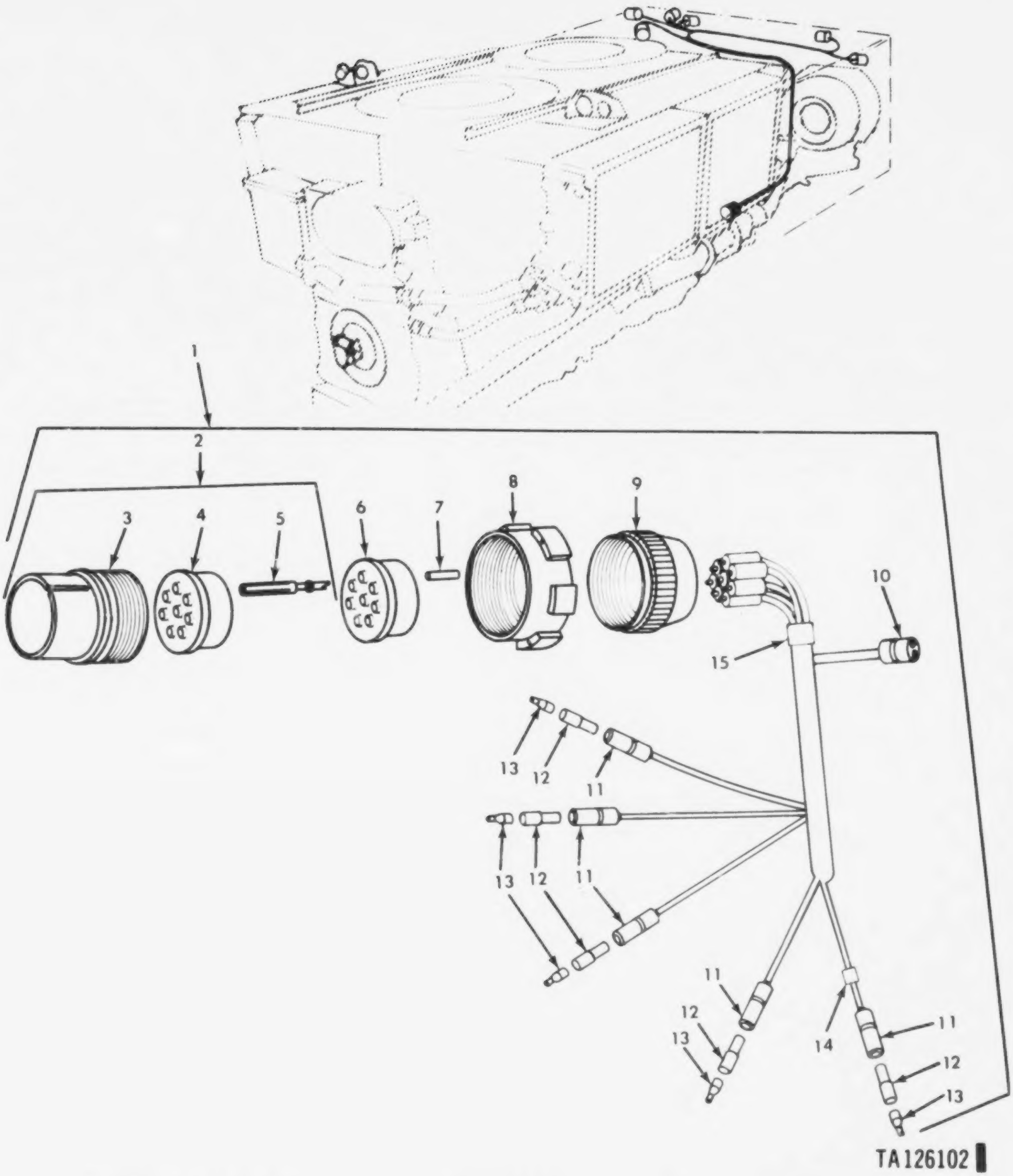
1
DETAIL A
2
3
4
5
6
DETAIL B
7
DETAIL C
10
9
DETAIL D
8
9
DETAIL E
TA126107

1 Rubber grommet
2 Capscrew
3 Loop clamp
4 Angle bracket
5 Lockwasher
6 Plain nut
7 Loop clamp
8 Loop clamp
9 Stamped nut
10 Loop clamp

Figure 3-299. Transmission wiring harness brackets and clamps.


1
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15
13
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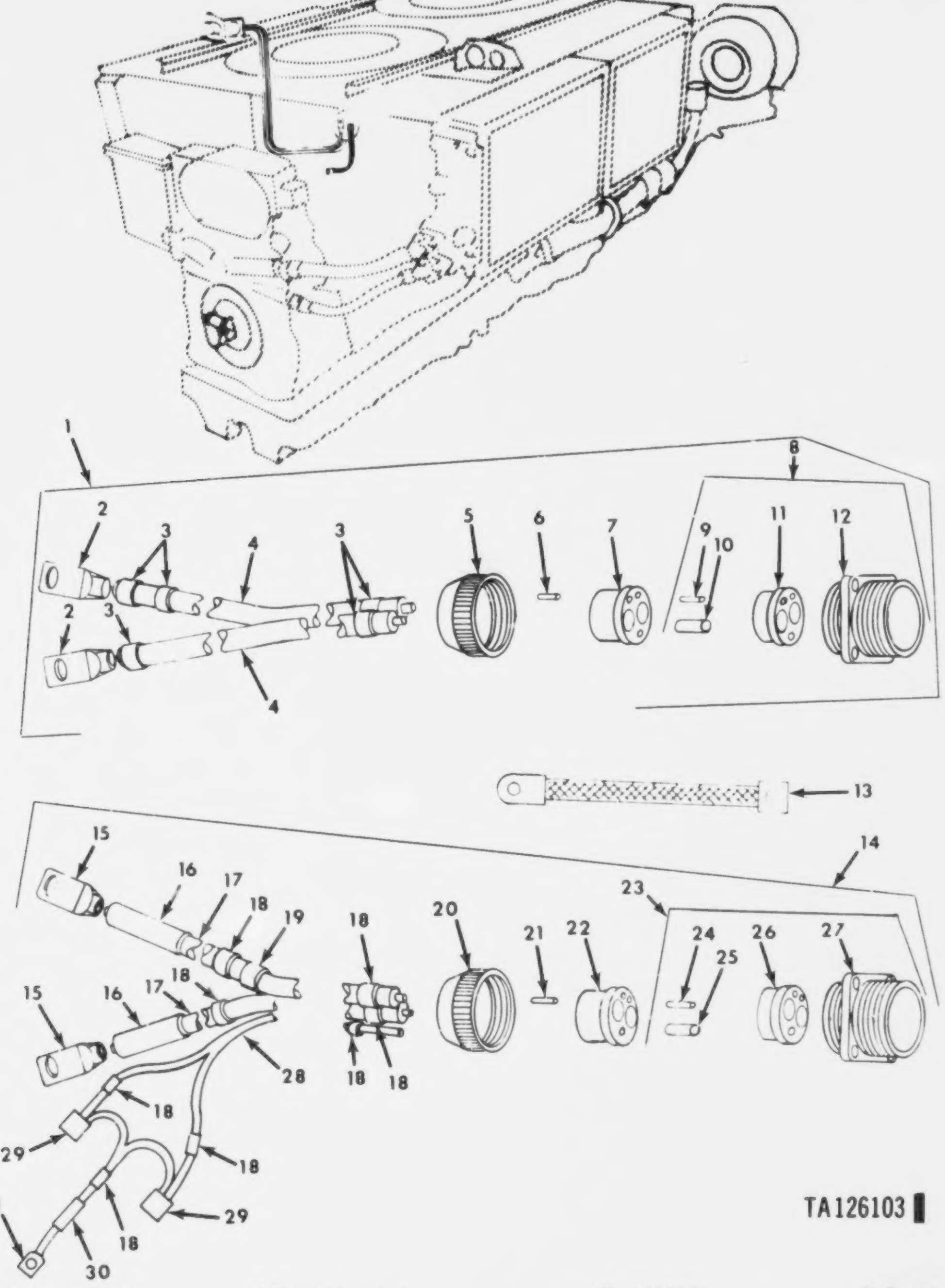
11
13
12
11
11
12
13
14
11
12
13
TA126102

1 Transmission wiring harness
2 Connector plug assembly
3 Connector shell
4 Insert connector
5 Electrical contact
6 Rubber bushing
7 Nonmetallic rod
8 Sleeve nut
9 Connector nut
10 Connector plug
11 Connector shell
12 Insulator bushing
13 Terminal
14 Band marker
15 Band marker

Figure 3-300. Transmission wiring harness connectors and terminals.


1
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16
17
18
28
18
18
18
29
18
31
29
18
30
TA126103

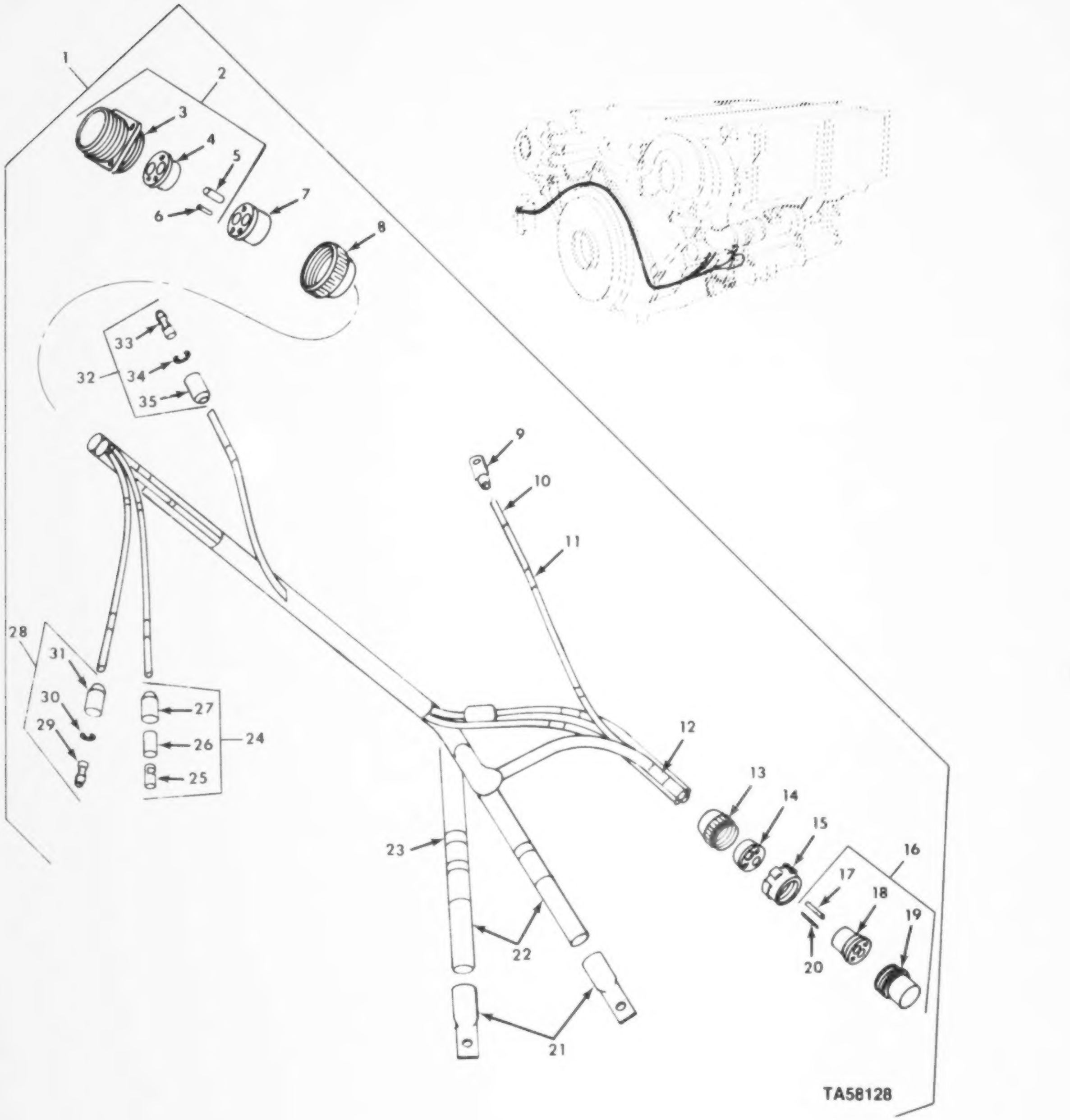
1 Wiring harness assembly
2 Terminal lug
3 Band marker
4 Electrical wire
5 Bushing retainer nut
6 Nonmetallic rod
7 Rubber bushing
8 Connector assembly

9 Electrical contact
10 Electrical connector
11 Connector insert
12 Connector shell
13 Electrical lead
14 Branched cable assembly
15 Terminal lug
16 Insulation sleeving

17 Electrical wire
18 Band marker
19 Band marker
20 Bushing retainer nut
21 Nonmetallic rod
22 Rubber bushing
23 Connector assembly
24 Electrical contact

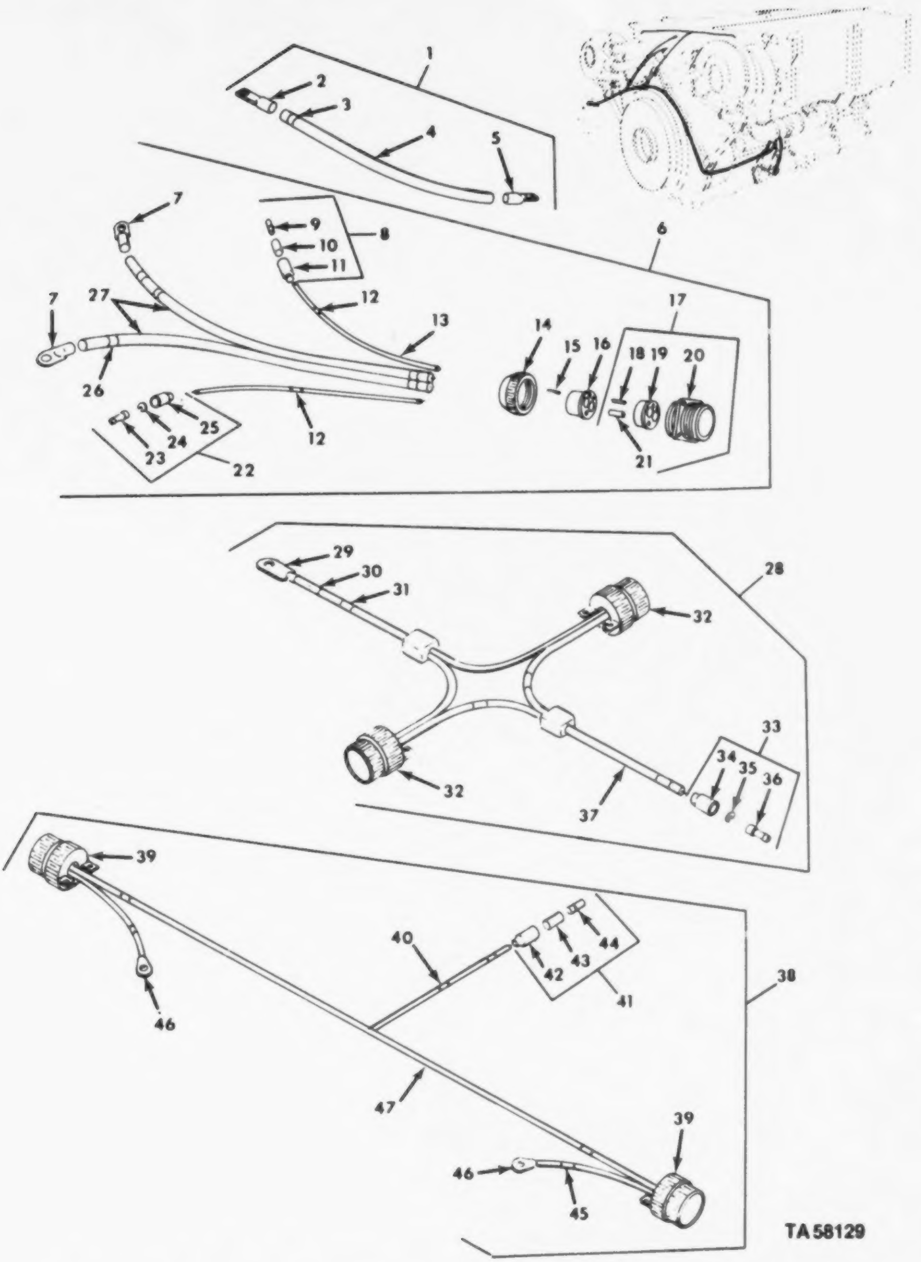
25 Electrical contact
26 Connector insert
27 Connector shell
28 Electrical wire
29 Plug connector
30 Sleeving insulation
31 Terminal lug

Figure 3-301. Starter cables and associated parts.



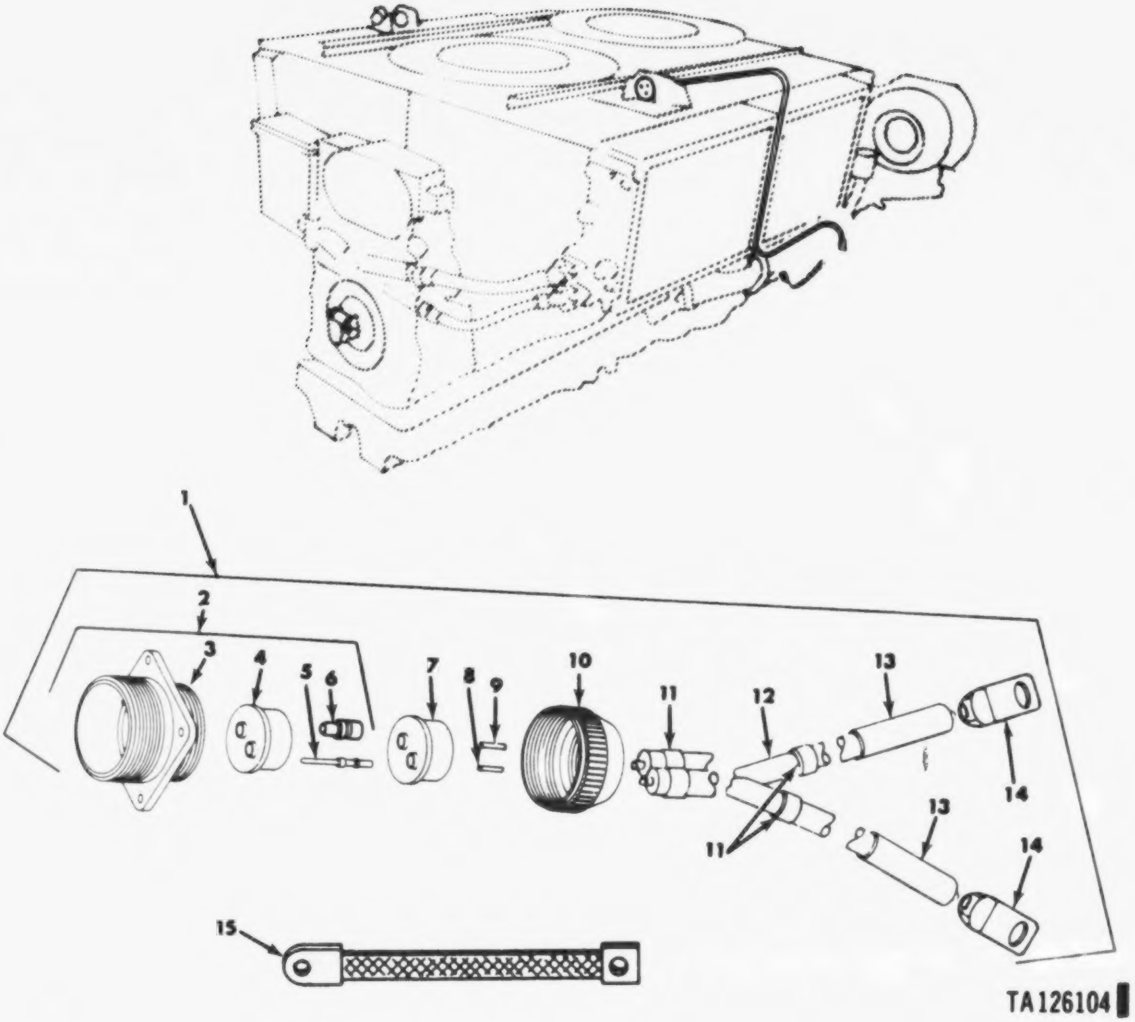
1 Wiring harness assembly
2 Connector assembly
3 Connector receptacle
4 Connector insert
5 Electrical contact
6 Electrical contact
7 Rubber bushing
8 Bushing retainer nut
9 Terminal lug
10 Insulation sleeving
11 Band marker
12 Band marker
13 Bushing retainer nut
14 Rubber bushing
15 Sleeve nut
16 Connector assembly
17 Electrical contact
18 Connector insert
19 Plug shell
20 Electrical contact
21 Terminal lug
22 Insulation sleeving
23 Band marker
24 Connector assembly
25 Terminal assembly
26 Insulator bushing
27 Connector shell
28 Connector assembly
29 Electrical contact
30 Slotted washer
31 Connector shell
32 Connector assembly
33 Electrical contact
34 Slotted washer
35 Connector shell

Figure 3-301.1. Starter wiring harness and associated parts (Model AVDS-1790-2DR).



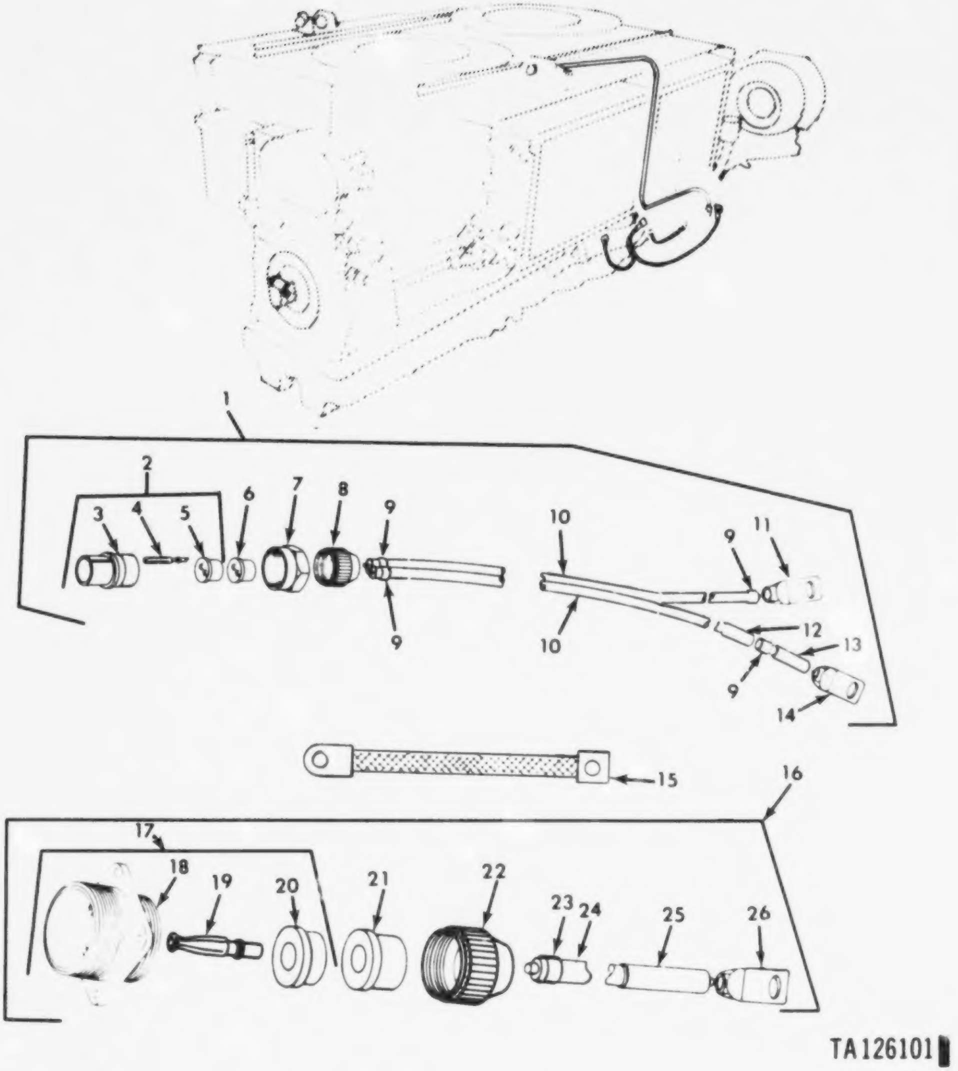
1 Starter ground lead assembly
2 Terminal lug
3 Band marker
4 Electrical wire
5 Terminal lug
6 Wiring harness assembly
7 Terminal lug
8 Connector assembly
9 Terminal assembly
10 Insulator bushing
11 Cable nipple
12 Band marker
13 Electrical wire
14 Bushing retainer nut
15 Nonmetallic rod
16 Rubber bushing
17 Connector assembly
18 Electrical contact
19 Connector insert
20 Connector receptacle
21 Electrical contact
22 Connector assembly
23 Electrical contact
24 Slotted washer
25 Connector shell
26 Band marker
27 Electrical wire
28 Branched cable assembly
29 Terminal lug
30 Band marker
31 Band marker
32 Plug connector
33 Connector assembly
34 Connector shell
35 Slotted washer
36 Electrical contact
37. Electrical wire
38. Wiring harness assembly
39. Plug connector
40. Band Marker
41. Connector assembly
42. Cable nipple
43. Insulator bushing
44. Terminal assembly
45. Band marker
46. Terminal lug
47. Electrical wire

Figure 3-301.2. Starter wiring harnesses and associated parts (Model AVDS-1790-2DR).



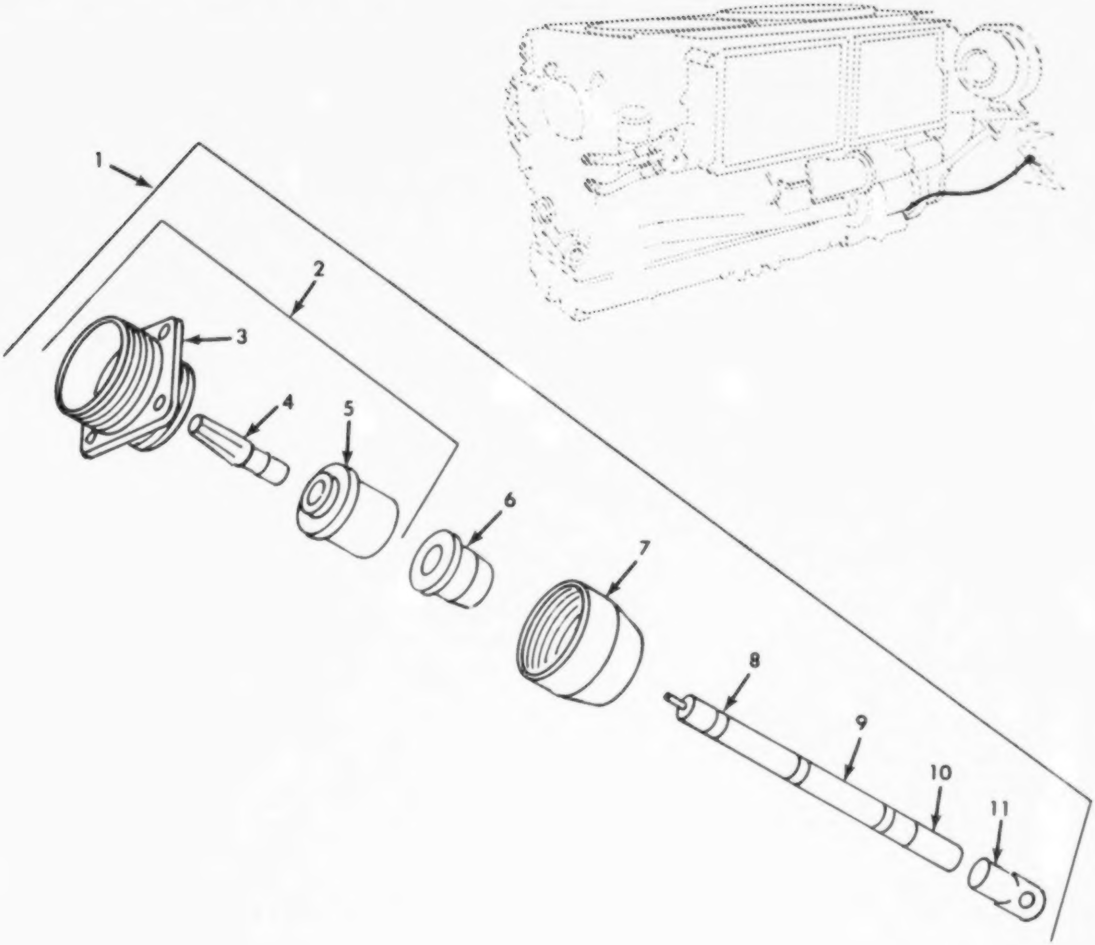
1 Generator electrical lead assembly
2 Receptacle connector assembly
3 Connector shell
4 Insert connector
5 Electrical contact
6 Electrical contact
7 Rubber bushing
8 Nonmetallic rod
9 Nonmetallic rod
10 Coupling nut
11 Band marker
12 Electrical wire
13 Insulation sleeving
14 Terminal lug
15 Generator ground electrical lead

Figure 3-302. Generator cables and associated parts (AVDS-1790-2C engine).



1 Lead assembly
2 Connector assembly
3 Connector shell
4 Electrical contact
5 Connector insert
6 Rubber bushing
7 Coupling nut
8 Bushing retainer nut
9 Band marker
10 Electrical wire
11 Terminal lug
12 Bank marker
13 Sleeving insulation
14 Terminal lug
15 Electrical lead
16 Lead assembly
17 Connector assembly
18 Connector shell
19 Electrical contact
20 Connector insert
21 Rubber bushing
22 Bushing retainer nut
23 Band marker
24 Electrical wire
25 Sleeving insulation
26 Terminal lug

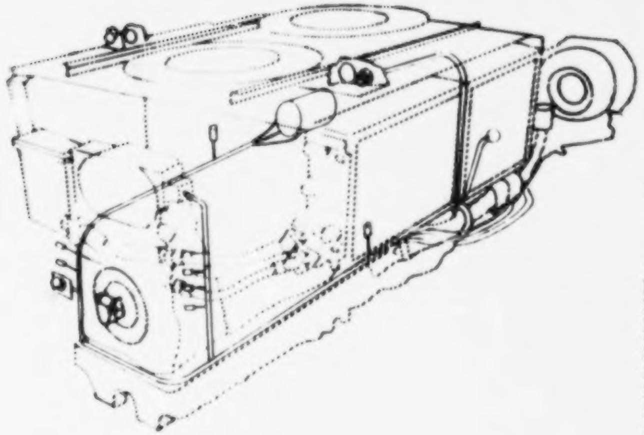
Figure 3-303. Generator cables, blower motor harness, and associated parts (AVDS-1790-2D engine).



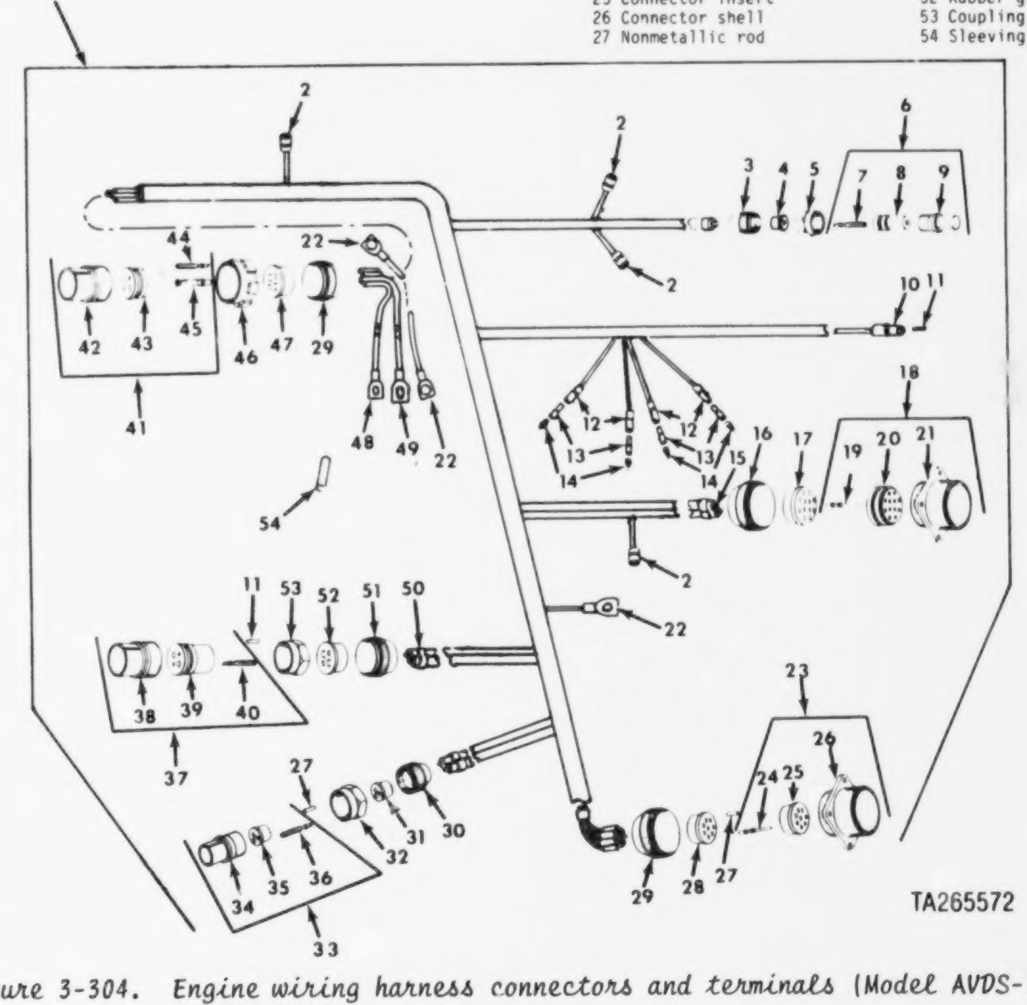
1 Generator electrical lead assembly	7 Bushing retainer nut
2 Connector assembly	8 Band marker
3 Connector shell	9 Electrical wire
4 Electrical contact	10 Insulation sleeving
5 Connector insert	11 Terminal lug
6 Rubber bushing	

TA58130

Figure 3-303.1. Generator electrical lead and associated parts (Model AVDS-1790-2DR).



1 Wiring harness assembly
2 Plug connector
3 Bushing retainer nut
4 Rubber bushing
5 Coupling nut
6 Connector assembly
7 Electrical contact
8 Connector insert
9 Connector shell
10 Plug connector
11 Nonmetallic rod
12 Connector shell
13 Insulator bushing
14 Terminal assembly
15 Band marker
16 Knurled plain nut
17 Rubber bushing
18 Connector assembly
19 Electrical contact
20 Connector insert
21 Connector shell
22 Terminal lug
23 Connector assembly
24 Electrical contact
25 Connector insert
26 Connector shell
27 Nonmetallic rod
28 Rubber bushing
29 Bushing retainer nut
30 Bushing retainer nut
31 Connector insert
32 Coupling nut
33 Connector assembly
34 Connector shell
35 Connector insert
36 Electrical contact
37 Connector assembly
38 Connector shell
39 Connector insert
40 Electrical contact
41 Connector assembly
42 Plug shell
43 Connector insert
44 Electrical contact
45 Electrical contact
46 Sleeve nut
47 Rubber bushing
48 Terminal lug
49 Terminal lug
50 Band marker
51 Bushing retainer nut
52 Rubber grommet
53 Coupling nut
54 Sleeving insulation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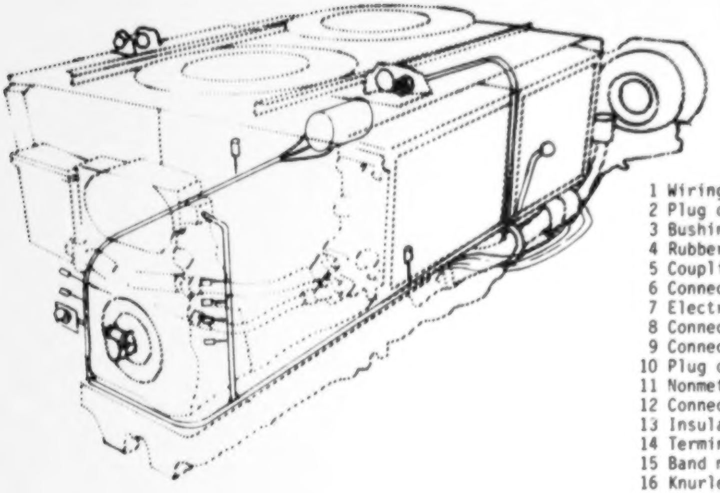
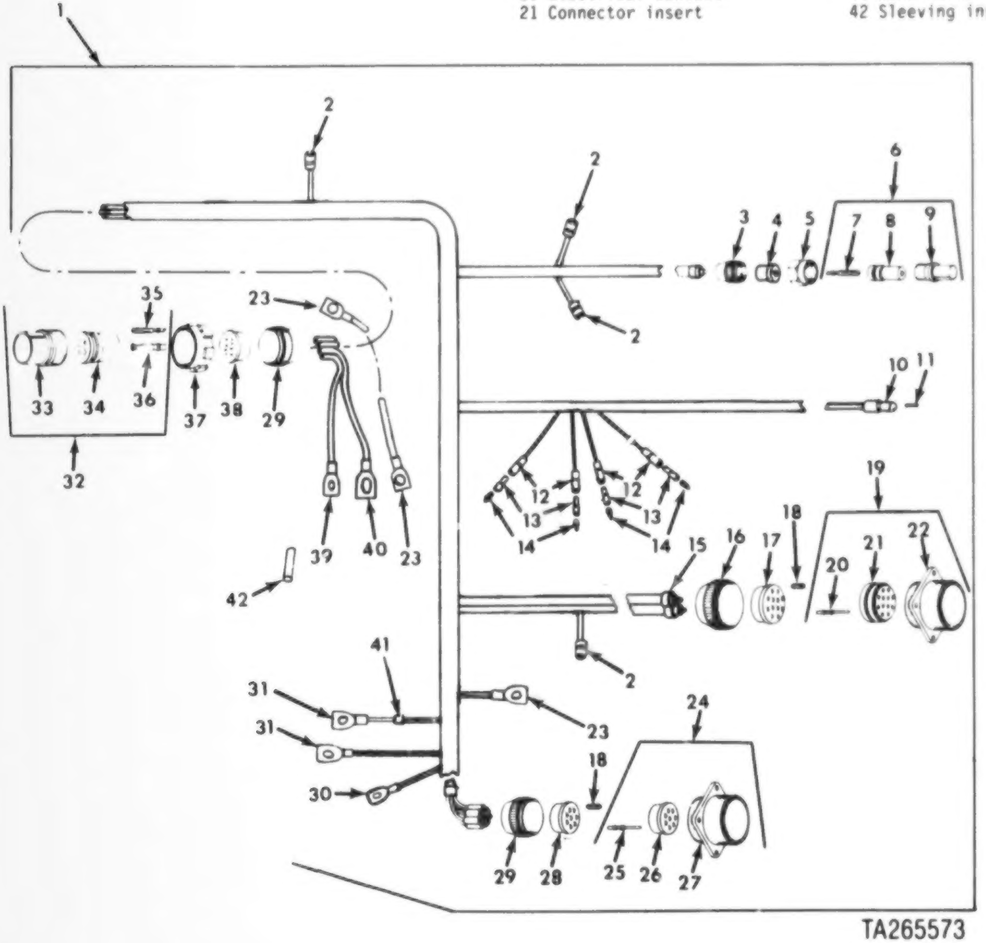
TA265572

Figure 3-304. Engine wiring harness connectors and terminals (Model AVDS-1790-2C) (Sheet 1 of 3).



1 Wiring harness assembly
2 Plug connector
3 Bushing retainer nut
4 Rubber bushing
5 Coupling nut
6 Connector assembly
7 Electrical contact
8 Connector insert
9 Connector shell
10 Plug connector
11 Nonmetallic rod
12 Connector shell
13 Insulator bushing
14 Terminal assembly
15 Band marker
16 Knurled plain nut
17 Rubber bushing
18 Nonmetallic rod
19 Connector assembly
20 Electrical contact
21 Connector insert
22 Connector shell
23 Terminal lug
24 Connector assembly
25 Electrical contact
26 Connector insert
27 Connector shell
28 Rubber bushing
29 Bushing retainer nut
30 Terminal lug
31 Terminal lug
32 Connector assembly
33 Plug shell
34 Connector insert
35 Electrical contact
36 Electrical contact
37 Sleeve nut
38 Rubber bushing
39 Terminal lug
40 Terminal lug
41 Band marker
42 Sleeving insulation


1
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35
23
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29
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12
13
13
14
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40
23
42
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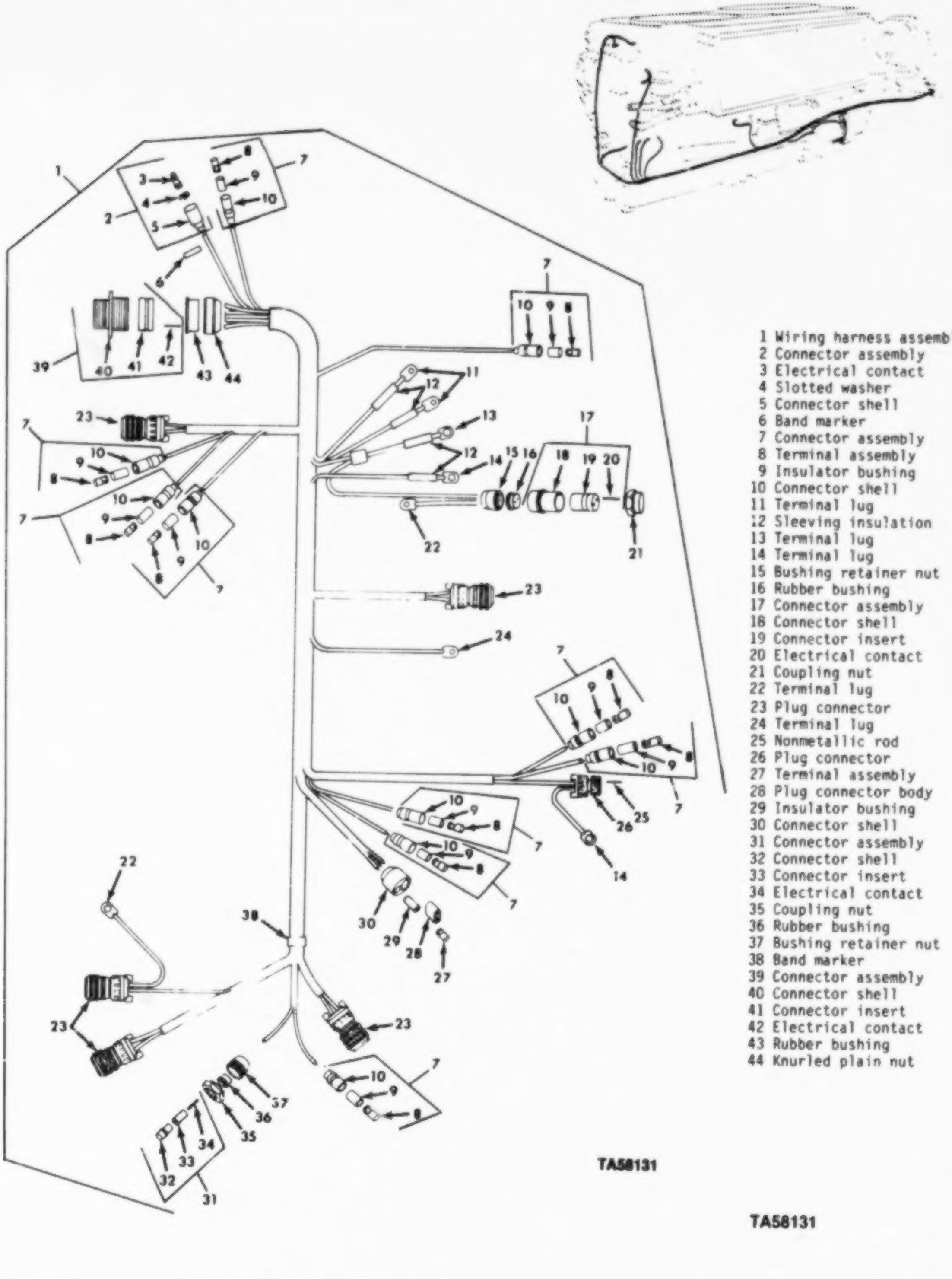
TA265573

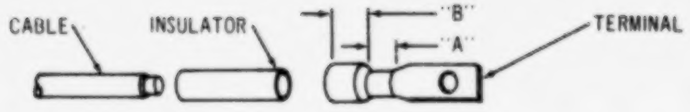
Figure 3-304. Engine wiring harness connectors and terminals (Model AVDS-1790-2D) (Sheet 2 of 3).



1	Wiring harness assembly
2	Connector assembly
3	Electrical contact
4	Slotted washer
5	Connector shell
6	Band marker
7	Connector assembly
8	Terminal assembly
9	Insulator bushing
10	Connector shell
11	Terminal lug
12	Sleeving insulation
13	Terminal lug
14	Terminal lug
15	Bushing retainer nut
16	Rubber bushing
17	Connector assembly
18	Connector shell
19	Connector insert
20	Electrical contact
21	Coupling nut
22	Terminal lug
23	Plug connector
24	Terminal lug
25	Nonmetallic rod
26	Plug connector
27	Terminal assembly
28	Plug connector body
29	Insulator bushing
30	Connector shell
31	Connector assembly
32	Connector shell
33	Connector insert
34	Electrical contact
35	Coupling nut
36	Rubber bushing
37	Bushing retainer nut
38	Band marker
39	Connector assembly
40	Connector shell
41	Connector insert
42	Electrical contact
43	Rubber bushing
44	Knurled plain nut

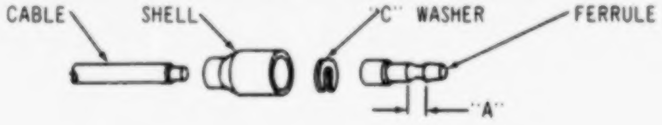
TA58131

Figure 3-304. Engine wiring harness connectors and terminals (Model AVDS-1790-2DR) (Sheet 3 of 3).


CABLE
INSULATOR
"B"
"A"
TERMINAL

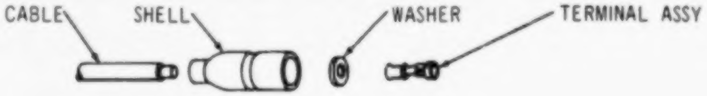
1 - STRIP CABLE INSULATION EQUAL TO DEPTH OF TERMINAL WELL.
2 - SLIDE INSULATOR OVER CABLE.
3 - INSERT CABLE INTO TERMINAL WELL AND CRIMP CONDUCTOR IN AREA "A" AND CABLE INSULATION IN AREA "B"
4 - SLIDE INSULATOR OVER CRIMPED END OF TERMINAL.

TERMINAL-TYPE CABLE CONNECTOR


CABLE
SHELL
"C" WASHER
FERRULE
"A"

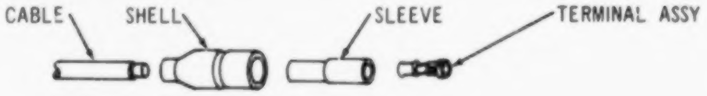
1 - STRIP CABLE INSULATION EQUAL TO DEPTH OF FERRULE WELL.
2 - SLIDE SHELL OVER CABLE.
3 - INSERT CABLE INTO FERRULE WELL AND CRIMP IN AREA "A" ONLY.
4 - PLACE "C" WASHER OVER CABLE AT REAR OF FERRULE. AND SLIDE SHELL OVER "C" WASHER AND TERMINAL.

MALE CABLE CONNECTOR


CABLE
SHELL
WASHER
TERMINAL ASSY

1 - STRIP CABLE INSULATION APPROXIMATELY 1/8-INCH.
2 - SLIDE SHELL OVER CABLE INSULATION.
3 - SLIDE WASHER OVER CONDUCTOR TO CABLE INSULATOR.
4 - INSERT CABLE INTO TERMINAL ASSEMBLY AND CRIMP.
5 - SLIDE SHELL AND WASHER OVER TERMINAL.

FEMALE CABLE CONNECTOR (WITH WASHER) - (12 GAGE CABLE)

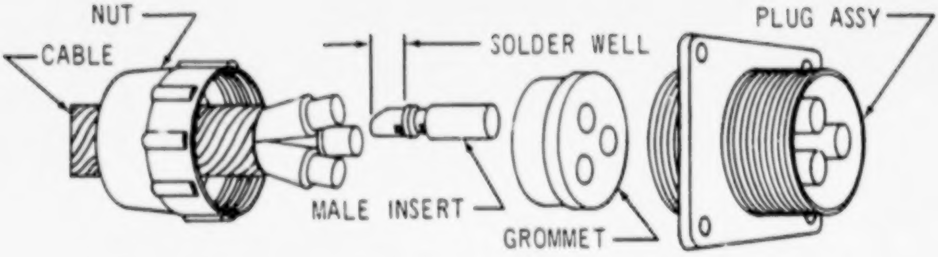

CABLE
SHELL
SLEEVE
TERMINAL ASSY

1 - STRIP CABLE INSULATION APPROXIMATELY 1/8-INCH.
2 - SLIDE SHELL AND SLEEVE OVER CABLE.
3 - INSERT CABLE INTO TERMINAL ASSEMBLY AND CRIMP
4 - SLIDE SHELL AND SLEEVE OVER TERMINAL

TA028583

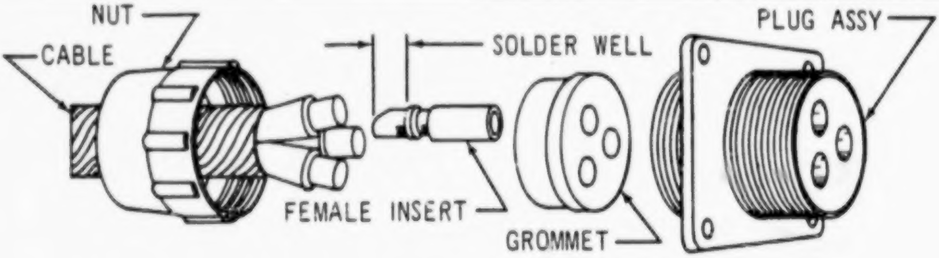
FEMALE CABLE CONNECTOR (WITH SLEEVE) - (14 AND 16 GAGE CABLE)

Figure 3-305. Replacement of cable connectors.



1 - STRIP CABLE INSULATION EQUAL TO DEPTH OF SOLDER WELLS OF INSERTS.
2 - REMOVE GROMMET RETAINING NUT FROM PLUG ASSEMBLY AND SLIDE BACK OVER CABLE.
3 - SLIDE GROMMET BACK FROM PLUG ASSEMBLY AND REMOVE DAMAGED CABLE.
4 - PASS REPLACEMENT CABLE THROUGH GROMMET RETAINING NUT AND GROMMET. INSERT INTO SOLDER WELLS OF INSERTS AND SOLDER.
5 - SLIDE GROMMET OVER INSERTS AND PRESS INTO PLUG ASSEMBLY.
6 - THREAD GROMMET RETAINING NUT TO PLUG ASSEMBLY.

TYPICAL MALE-TYPE PLUG ASSEMBLY

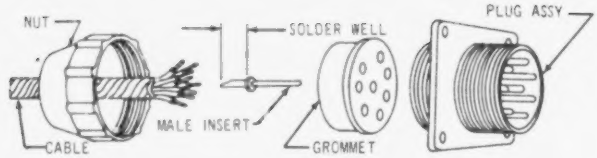


1 - STRIP CABLE INSULATION EQUAL TO DEPTH OF SOLDER WELLS OF INSERTS.
2 - REMOVE GROMMET RETAINING NUT FROM PLUG ASSEMBLY AND SLIDE BACK OVER CABLE.
3 - SLIDE GROMMET BACK FROM PLUG ASSEMBLY AND REMOVE DAMAGED CABLE.
4 - PASS REPLACEMENT CABLE THROUGH GROMMET RETAINING NUT AND GROMMET INSERT INTO SOLDER WELLS OF INSERTS AND SOLDER.
5 - SLIDE GROMMET OVER INSERTS AND PRESS INTO PLUG ASSEMBLY.
6 - THREAD GROMMET RETAINING NUT TO PLUG ASSEMBLY.

TYPICAL FEMALE-TYPE PLUG ASSEMBLY

TA028584

Figure 3-306. Replacement of cable male and female plugs.



1 - STRIP CABLE INSULATION EQUAL TO DEPTH OF SOLDER WELLS OF INSERTS.
2 - REMOVE GROMMET RETAINING NUT FROM PLUG ASSEMBLY AND SLIDE BACK OVER CABLE.
3 - SLIDE GROMMET BACK FROM PLUG ASSEMBLY AND REMOVE DAMAGED CABLE
4 - PASS REPLACEMENT CABLE THROUGH GROMMET RETAINING NUT AND GROMMET INSERT INTO SOLDER WELLS OF INSERTS. AND SOLDER.
5 - SLIDE GROMMET OVER INSERTS AND PRESS INTO PLUG ASSEMBLY UNTIL SEATED.
6 - THREAD GROMMET RETAINING NUT TO PLUG ASSEMBLY.

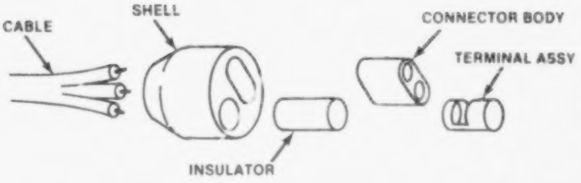
TYPICAL MALE-TYPE PLUG ASSEMBLY TA028615

Figure 3-307. Replacement of cable male receptacles.

NOTE

> Rubber-to-rubber contacts of bell-type connectors may be lubricated lightly with silicone compound MIL-S-8660 to assist assembly.

c. Installation of Jumper Wire. To substitute a jumper wire for a defective harness wire, tape jumper wire to the exterior of the harness; do not disassemble the harness. Disassemble the connectors as shown in figures 3-306 through 3-307.1 and unsolder or uncrimp the defective wire. Strip the insulation from end of the jumper wire to the depth of solder well on contact insert or approximately 1/8 inch when used with a terminal assembly. Pass the jumper wire through the grommet retaining nut and grommet and solder to the insert or pass the jumper wire through the connector body and insulator or shell and crimp to the terminal assembly. Reassemble the connector.



1 - STRIP CABLE INSULATION APPROXIMATELY 1/8-INCH.
2 - SLIDE INSULATOR OR CONNECTOR BODY BACK FROM SHELL AND REMOVE DAMAGED CABLE.
3 - PASS REPLACEMENT CABLE THROUGH SHELL AND INSULATOR OR CONNECTOR BODY AND INSERT INTO TERMINAL ASSEMBLY AND CRIMP.
4 - SLIDE INSULATOR OR CONNECTOR BODY OVER TERMINAL ASSEMBLY AND PRESS INTO SHELL.

TYPICAL FEMALE-TYPE PLUG ASSEMBLY **TA58132**

Figure 3-307.1 Replacement of cable female connector

d. A cable that has been repaired by installing a jumper wire should be brushed or sprayed with clear electrical ignition waterproofing varnish MIL-V-13811. Allow varnish to dry for approximately 24 hours before handling. The varnish is not a conductor of electricity, so care must be taken to avoid overspraying the varnish on contact surfaces of wire terminals, connector contacts, or similar parts where it will prevent the flow of electricity.

3-155. Assembly

Install the wiring harness assembly to the power plant as outlined in paragraph 2-49a(2) for the AVDS-1790-2C engine assembly, and paragraph 2-49b(2) for the AVDS-1790-2D engine assembly, and paragraph 2-49c(2) for the AVDS-1790-2DR engine assembly.

Section XXVII. GENERAL ASSEMBLY PROCEDURES

3-156. Cleanliness

The engine is a precision product and extreme care and cleanliness must be exercised in all phases of assembly operations to insure satisfactory engine performance. Dirt and dust, even in minute quantities, are abrasive. After cleaning and just before assembly, coat all bearings, shafts, and contact surfaces with engine oil (OE). This will insure sufficient lubrication of moving parts when first put into operation.

3-157. General Assembly Instructions

a. Always use new gaskets when assembling the engine. Use new preformed packings and annular copper gaskets throughout engine assembly. An engine overhaul parts kit 5704488, consisting of all necessa gaskets and preformed packings, is available for us during engine repair.

b. Several of the components of the engine are available in kits or sets. Whenever a kit or set is used for parts replacement, all applicable components of the kit or set should be installed.

c. When torque tightening nuts, bolts, and screws, and a torque specification is not noted in the text or illustration covering the installation, it is understood that the standard torque values in paragraph 3-41 prevail. Whenever a nut, bolt or screw requires that special attention be given, the torque value will be noted in the text or illusration pertaining to that operation. Torque wrench readings are of no value, unless properly used. It must be understood that it is not the force necessary to turn the nut, bolt, or screw that is important, but the resultant pull on the part that completes the union. Therefore, resistance of the nut to turning must be kept to a minimum. Threads must be clean and undamaged, and lubricated with OE30 engine oil or GAA grease to reduce the friction.

NOTE

> When using a torque wrench, the final reading must be taken while the nut, capscrew, or bolt is turning. When torque reading is close to that specified when wrench is at the end of its swing, back off the nut slightly and change wrench position; then pull to the desired reading while the nut is turning. To start a partially tightened nut will require a much higher torque than that required to keep a nut turning. The ratio of pounds-torque to pounds-pull on a bolt is not an even ratio and excess torque may easily overstress the bolt. Under-torquing bolts and studs subject to cyclic loads such as cylinder base studs and connecting rod bolts will result in fatigue failures. It is therefore important that the torque values specified in this manual be followed to avoid failures of fasteners.

d. All bolts and nuts should be secured with lock nuts, tab washers, locking wire, lockwasher, or cotter pins, as specified. Many engine failures have been traced to neglect of this simple precaution.

3-158. Installation Instructions

The same illustrations support both removal and installation procedures, references to illustrations contained in Chapter II and III are used throughout this section.

Section XXVIII. ASSEMBLY OF ENGINE FROM SUBASSEMBLIES

3-159. General

This section covers instructions for complete assembly of the engine from subassemblies, and installation of engine accessories. Components are grouped together in proper assembly order. The crankcase assembly was partially assembled during repair of engine components. Normally the crankcase assembly will be on the overhaul stand after it has been inspected and the main bearing bores have been checked. If the crankcase is not on the stand, install on maintenance and overhaul stand, part number 10912260, (fig. 3-147) and rotate stand so that oil pan flanges are up.

3-160. Starter Drive Gearshaft

Install new preformed packing on starter driven gearshaft bearing cage and install bearing cage in crankcase assembly (fig. 3-140). Secure bearing cage to crankcase assembly with six slotted nuts (fig. 3-139) and secure slotted nuts with locking wire.

3-161. Generator and Idler Gears, Piston Oiler Nozzle, and Crankshaft and Connecting Rod Assembly

a. Install new preformed packing (fig. 3-308) on starter idler gearshaft and install idler gear and aline with idler gearshaft bore in crankcase. Secure starter idler gearshaft to crankcase with

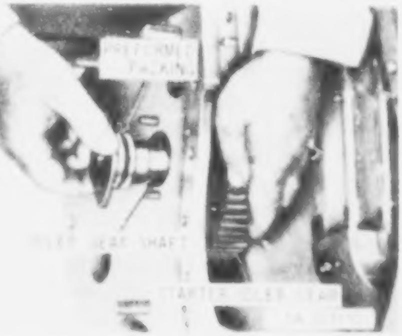


Figure 3-308. Installing starter idler gear.

two slotted nuts (fig. 3-137) and secure nuts with locking wire. Install generator idler gear and gearshaft in the same manner.

b. Install twelve crankcase protectors 10882790 (fig. 3-106). Install six piston oiler squirt nozzle assemblies and secure to crankcase with twelve slotted nuts and secure nuts with locking wire (fig. 3-136).

NOTE

> Numbers 1 through 7 indicate main bearing sleeve locations beginning from the front of crankcase.

c. Install upper main thrust sleeve bearing half (fig. 3-135) marked "4-case" in main bearing bore and install six upper main sleeve bearing halves in other bearing bores in accordance with respective location marks. Coat bearing halves with OE30 engine oil or GAA grease.

d. Exercise care when installing crankshaft assembly to prevent damage to the main bearing cap studs and crankshaft journals. Before installing crankshaft and connecting rod assemblies place cardboard or plastic tubes over main bearing studs for protection. If such tubes are not available, cover studs with industrial tape.

NOTE

> The connecting rods are installed on the crankshaft in pairs. The connecting rod of each pair toward the flywheel end (rear) serves the left bank cylinders; the connecting rod toward the front of the engine serves the right bank.

e. The crankshaft and connecting rod sling 10882958 consists of a cable and two adapters. The adapter with the dowel pin hole attaches to the crankshaft flywheel flange. The other adapter attaches to the torsional vibration damper mounting flange.

f. In order for the crankshaft to clear the crankcase when it is installed, the counterweights for connecting rod bearing journals 1R and 1L and 6R and 6L must be in the position shown in figure 3-131, therefore install the sling adapter on the flywheel flange dowel pin making sure the No. 1 and 6 rod bearing journals are in the downward position. Secure the adapter to the flange with two bolts used to secure the flywheel. Install the other sling adapter to the torsional vibration damper flange and secure with two vibration damper mounting bolts.

g. Using a suitable hoist install crankshaft and connecting rod assembly as shown in figure 3-134. Guide the connecting rods through the cylinder mounting holes and past the connecting rod protectors.

h. Remove two flywheel bolts (fig. 3-132) and two vibration damper mounting bolts (fig. 3-133) and remove crankshaft and connecting rod sling.

i. Coat outer edges of bearing caps, bearing halves and machined surface of the crankcase webs with engine oil to facilitate installation of caps. Install number 4 (center) thrust bearing cap (fig. 3-309) and bearing half in position on crankcase studs. Use crankcase spreading tool 8708361 to spread crankcase so bearing caps will slide over studs and into position in the crankcase.

NOTE

> The main bearing caps and main bearing halves must be installed in their original position according to location number identification on the cap and bearing half.

j. Install the remaining six bearing halves in caps and similarly install caps and bearings in crankcase.

NOTE

> The side of each main bearing cap identified as "fly end" must be installed toward flywheel end or rear of engine.

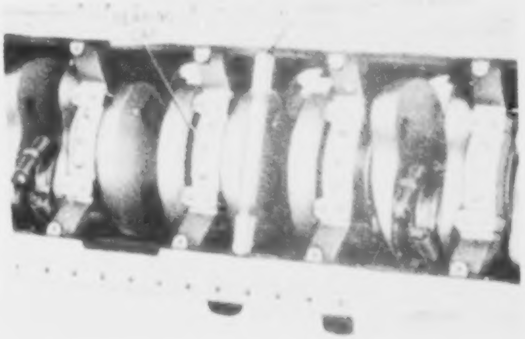


Figure 3-309. Installing main bearing caps using crankcase spreading tool.

k. Mount a dial indicator (fig. 3-310) on crankcase so indicator point contacts drive gear flange on crankshaft. Using a heavy duty screwdriver, wedge between main bearing cap and crankshaft counterweight, push crankshaft toward front end. Set indicator on zero r g ("O"). Using a heavy duty screwdriver, pus kshaft toward the rear of crankcase and check indicator end play reading. End play should be from 0.011 to 0.019 inch. When end play exceeds 0.019 inch, remove bearing caps and crankshaft. Install new main thrust bearing halves. Install bearing cap and recheck thrust bearing bore (para 3-45*d*). Then install bearing halves and crankshaft, and recheck end play to make sure it is within limits.

l. Remove crankcase spreading tool (fig. 3-309). Apply OE engine oil or GAA grease and install two plate washers and four slotted nuts (fig. 3-129) securing main thrust bearing cap (No. 4) to crankcase assembly. Apply OE engine oil or GAA grease

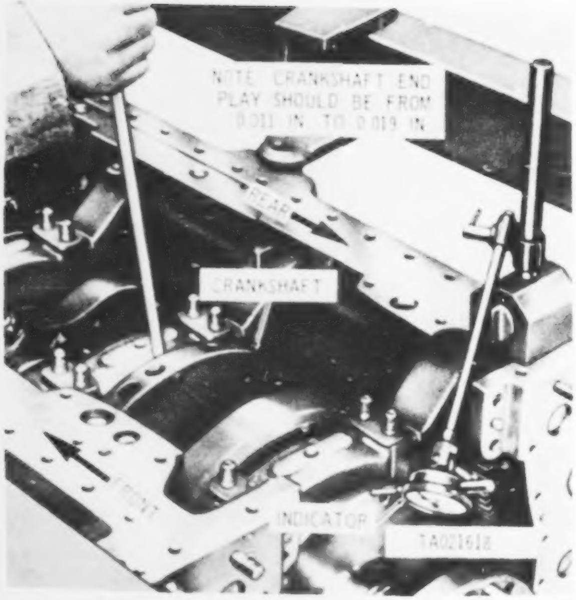

NOTE: CRANKSHAFT END PLAY SHOULD BE FROM 0.011 IN. TO 0.019 IN.
REAR
CRANKSHAFT
FRONT
INDICATOR
TA021618

Figure 3-310. Checking crankshaft end play.

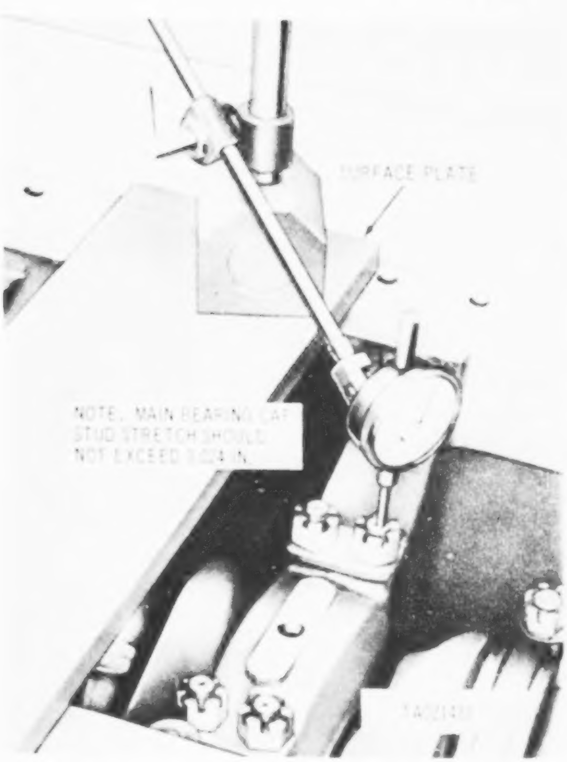

SURFACE PLATE
NOTE: MAIN BEARING CAP STUD STRETCH SHOULD NOT EXCEED 0.024 IN.

Figure 3-311. Measuring main bearing stud stretch using dial indicator.

and install twelve plate washers and twenty four slotted nuts securing main bearing caps numbers 1, 2, 3, 5, 6, and 7 to crankcase assembly. Do not torque tighten or install locking wire at this time. Check and record the height of each stud using a flat surface plate and dial indicator as shown in figure 3-311.

m. Install twelve crankcase rods through crankcase and install six plate washer (4, fig. 3-128), twelve slotted nuts (1) and cotter pins. Position lower No. 7 main bearing crankcase rods (6) through crankcase from opposite (right) side of crankcase and install plate washer, slotted nut and cotter pin. Install upper crankcase rod at No. 7 main bearing through crankcase and install plate washer, slotted nut (3), and cotter pin. Push the thirteen crankcase rods (2, fig. 3-127) through crankcase assembly and install slotted nut on opposite (left) side of lower crankcase rod (4) and install slotted nut (3) on upper crankcase rod. Install six plate washers and twelve slotted nuts (1) on twelve crankcase rods (2).

n. Starting at number 4 main thrust bearing and alternating right and left, successively torque tighten all main bearing stud nuts to 500 pound-inches, then, following the same procedure and sequence, torque tighten all nuts to a final torque of 700 to 825 pound-inches.

o. Following the same procedure as (1) above, recheck stud height and apply sufficient additional torque to each nut, to aline nut slot with drilled ole in stud, and to obtain a stud stretch of 0.019 to 0.022 in. Do not exceed 0.024 in. Stud stretch is defined as the difference between the original height recorded in (1) above, and the height observed after nuts have been torque tightened, refer to torque specifications (para 3-41). Secure nuts with locking wire (fig. 3-129). If stud stretch exceeds 0.022 inch when torque tightening to 750 pound-inches, the stud is defective and must be replaced. Refer to paragraph 3-38 for stud replacement.

3-162. Accessory Drive Gear, Crankshaft Oil Seal Housing, Transmission Housing Adapter or Transmission Adapter, Flywheel Adapter, and Flywheel

a. Install accessory drive gear on crankshaft and alternately tighten twelve bolts (fig. 3-125) to draw drive gear on to crankshaft flange. Secure bolts with locking wire. Check backlash between accessory drive gear teeth and starter drive idler gear as shown in figure 3-312.

b. Install oil seal housing support (fig. 3-124) on dowel pins (fig. 3-125) in crankcase and secure with four cap and flat washers (fig. 3-124). Install new candlewick packing in four openings at the crankcase and oil seal housing support parting line as shown in figure 3-313.

c. The crankshaft oil seal was installed on the crankshaft during repair (fig. 3-171). Rotate the oil seal on the crankshaft until ends of oil seal join 30 degrees from centerline of crankshaft looking at the rear of the engine as shown in figure 3-314. This assists in controlling oil seepage past the split line of the oil seal.

d. Install a new oil seal cap and housing gasket (fig. 3-123) on crankcase assembly and install oil seal cap and housing around crankshaft, over the oil seal and on locating dowel pins in crankcase assembly and housing. Secure oil seal cap and housing to crankcase asssembly with twenty drilled head bolts (fig. 3-122) and flat washers. Secure bolts with locking wire. Secure oil seal cap to oil seal housing with four slotted nuts and flat washers and secure nuts with locking wire.

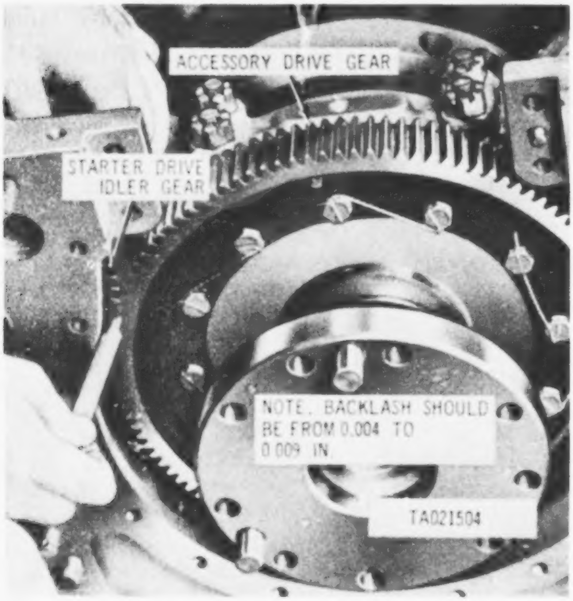


Figure 3-312. Checking accessory drive gear and starter idler gear backlash.

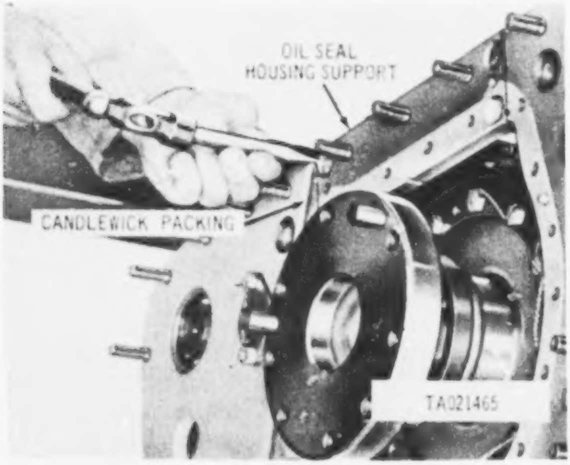


Figure 3-313. Installing candlewick packing between crankcase and oil seal housing support.

e. Position retainer on oil seal housing and secure with three drilled head bolts (fig. 3-121) and secure bolts with locking wire. Install retainer on oil seal cap and secure with three drilled head bolts and secure bolts with locking wire.

f. Refer to figure 3-127 and with the aid of an assistant holding the slotted nuts on opposite side of crankcase, tighten crankcase rod nuts to 640 pound-inches, plus additional torque to aline slotted nut with hole in rod. Install fourteen cotter pins to secure nuts. Care should be taken so that rods extend equally on both sides of crankcase and slotted nuts aline with holes in engine crankcase rods in tighten direction.

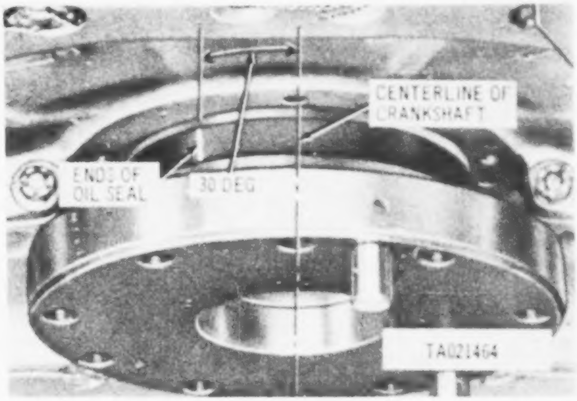


Figure 3-314. Correct position of crankshaft oil seal split line before installing oil seal retainer.

g. Install a new transmission adapter gasket on crankcase assembly. Attach a suitable chain hoist in transmission adapter lifting eye (fig. 3-120) and install transmission adapter on studs and dowel pins in crankcase. Secure transmission adapter to crankcase assembly with four self-locking nuts (fig. 3-119) and 15 slotted nuts and two slotted nuts and secure slotted nuts with locking wire.

NOTE

Model AVDS-1790-2DR engine transmission adapter is not equipped with the two large dowel pins or timing pointer.

NOTE

The flywheel dowel pins (fig. 3-314) are so located that the flywheel can be installed on the crankshaft flange in only one position.

h. Install eye bolt MS51937-7 in threaded hole provided in flywheel (fig. 3-315). Attach a suitable chain hoist to eye bolt and aline dowel pin holes in flywheel with dowel pins in crankshaft flange. Turn crankshaft as necessary to aline dowel pins with holes in flywheel. Position alined flywheel against flange on crankshaft and install three 9/16 x 1-3/4 in. flywheel mounting bolts and alternately tighten bolts to draw flywheel toward flange on crankshaft. These mounting bolts are also used to secure transmission drive spur gear to the crankshaft.

NOTE

> Eye bolt MS51937-7 must be removed from flywheel, before flywheel is drawn tight against flange on crankshaft, to permit flywheel to clear transmission adapter lifting eye.

i. Remove lifting eye bolt and continue to tighten three bolts until flywheel is tight against flange, then remove the bolts.

j. Install transmission drive spur gear on dowel pins (fig. 3-315) which protrude through flywheel and install three new lock plates (fig. 3-117) and secure lock plates, spur gear and flywheel to crankshaft with nine bolts. Alternately tighten bolts to 1000 pound-inches and secure bolts by bending tabs on three lock plates.

k. Check flywheel runout as shown in figure 3-316 using dial indicator. Runout should not exceed 0.015-inch. Replace flywheel if runout exceeds this limit.

k.1. Install preformed packing. Install transmission housing adapter (fig. 3-118.4) and two capscrews and self-locking nuts, and 17 capscrews and lockwashers. Install flywheel adapter and secure with nine machine bolts and new lock plates (fig. 3-118.2). Torque machine bolts to 1000 pound-inches and bend lock plate tabs against machine bolt head flats.

k. 2. Install flywheel using eye bolt, part number MS51937-7, (fig. 3-118.1) and secure with eight ma-

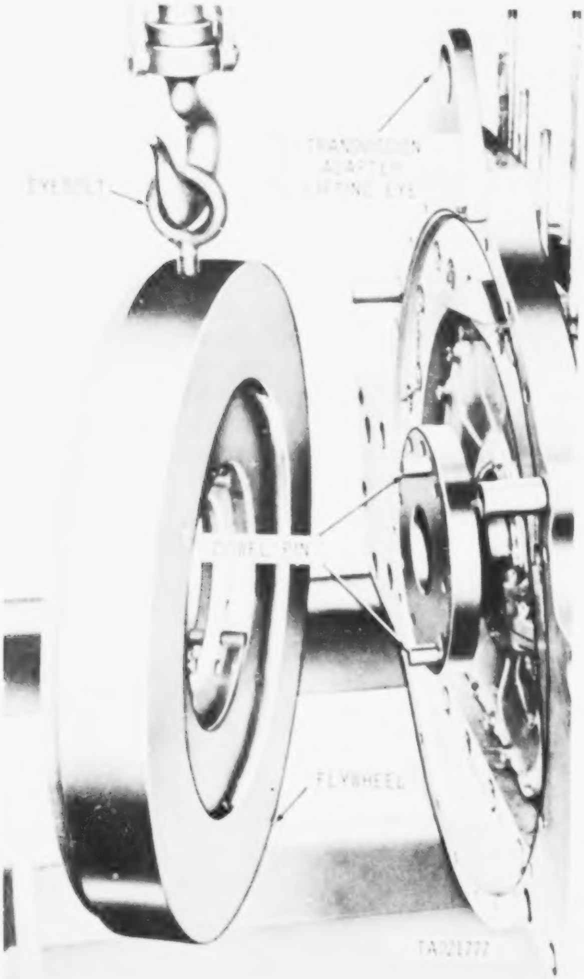


Figure 3-315. Installing flywheel using eye bolt, model AVDS-1790-2C and AVDS-1790-2D engines.

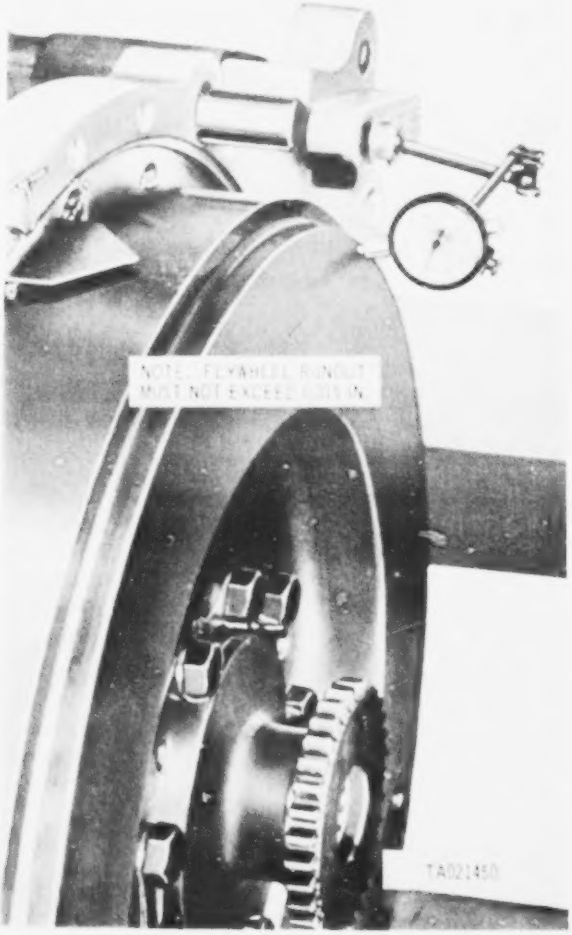


Figure 3-316. Checking flywheel runout using dial indicator, model AVDS-1790-2C and AVDS-1790-2D engines.

chine bolts. Torque machine bolts to 1000 pound-inches, and install locking wire.

k. 3. Check flywheel runout as shown in figure 3-316. Runout shall not exceed 0.015-inch. Replace flywheel if runout exceeds this limit.

3-163. Starter and Generator Drive Adapters, Vibration Damper, Oil Pump and Baffle

a. Using a new generator drive adapter gasket, install generator drive adapter (fig. 3-116, Models AVDS-1790-2D and AVDS-1790-2DR) and (fig. 3-115, Model AVDS-1790-2C) with drive gearshaft and bearings as a unit. Secure generator drive adapter assembly to crankcase assembly with five bolts and lockwashers and one self-locking nut and flat washer on stud behind adapter.

b. Install starter driven gear and secure to starter driven gearshaft with slotted nut (fig. 3-113) and cotter pin. Using new starter drive adapter gasket (4, fig. 3-112), install starter drive adapter (3) and secure to crankcase assembly with four self-locking nuts and flat washers (2). Install two starter mounting bolts (1) in adapter.

c. Install torsional vibration damper on crankshaft and position fuel pump drive coupling (fig. 3-110) and fuel pump drive coupling adapter on damper and secure the adapter and torsional vibration damper to the crankshaft with six drilled head bolts. Torque bolts to 1000-pounds-inch and secure with locking wire.

c.1. Install torsional vibration damper on crankshaft and position spur gearshaft on damper (fig. 3-110.1) and secure damper and gearshaft to crankshaft with six drilled head bolts. Torque bolts to 1000 pound-inches and secure with locking wire.

d. Install oil pan pressure compartment baffle on crankcase and secure with six capscrews and lockwashers (fig. 3-109).

e. Install oil pump assembly (with one mounting capscrew and two preformed packings in place) on crankcase assembly and tighten capscrew located behind the oil pressure relief valve as oil pump is being installed. Secure oil pump assembly with four capscrews and flat washers (5, fig. 3-108). Install pressure compartment baffle bracket (2) and secure to oil pan pressure compartment baffle with two self-locking nuts and bolts (4) and to oil pump with capscrew (1). Install locking wire.

f. Install new preformed packing on leveling oil pump transfer tube (3, fig. 3-107) and position tube assembly behind oil pan pressure compartment baffle with the tube end installed in opening in oil pump assembly and the flange end inserted in opening in pressure compartment baffle (4). Secure tube with two-self-locking nuts and capscrews (2). Install new leveling pump transfer tube seal (1) on exposed end of tube.

3-164. Pistons and Pins, Cylinder Assemblies, Cylinder Air Deflectors, Crankshaft Damper and Oil Filter Housing, Oil Pan, and Sending Units

a. The pistons are marked for identification as shown in figure 3-317 to aid in installing the pistons in their proper position. The piston boss is stamped with an arrow and the cylinder location (1R) to identify the cylinder from which the piston was removed and to assure piston will be returned to its original cylinder. The arrows on the piston pin bosses are pointed up, or to the exhaust outlet port. Cylinders are stamped with position markings at the intake valve side (bottom) of valve rocker arm cover flange. Markings of any piston or cylinders must be renewed if position marks and/or arrows are not entirely legible. Replacement piston must be marked to the corresponding cylinder it is to be used with. Always keep piston pin with its respective piston.

NOTE

When replacing damaged or worn pistons it is important that all of the engine's pistons be of the same size (oversize) and same weight, all having identical oversize and weight code markings. Refer to figure 3-182.1 and table 3-9.3 for oversize and weight code markings.

b. Coat pistons with GAA grease or engine oil and stagger the four piston ring gaps 90 degrees apart.

NOTE

For instructional purposes, the installation of only one cylinder assembly is described. The remaining cylinder as-

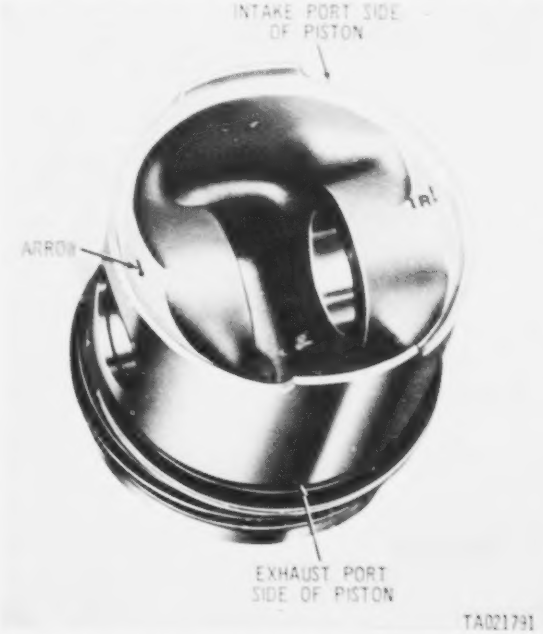


Figure 3-317. Piston installation position marks.

semblies should be installed in the same manner.

NOTE

Wash cylinder bores thoroughly just prior to engine assembly, using a power brush with hot (160°F.) soapy water. Cylinder bores should then be oiled to prevent rust.

c. Rotate engine overhaul stand until right bank cylinder holes, with connecting rod protectors, are positioned to received cylinder Nos. 1R through 6R.

d. Install piston and rings (fig. 3-318) in cylinder assembly using compressor and gage 10882888. The piston position number (fig. 3-317) must always correspond to the cylinder number marked on intake valve side of valve rocker arm cover flange. The arrow on the piston boss must be directed toward the exhaust port outlet. Guide piston and rings into cylinder until all piston rings have entered the cylinder bore. Slide the compressor from piston and ring assembly. Install remaining pistons in cylinders in the same manner.

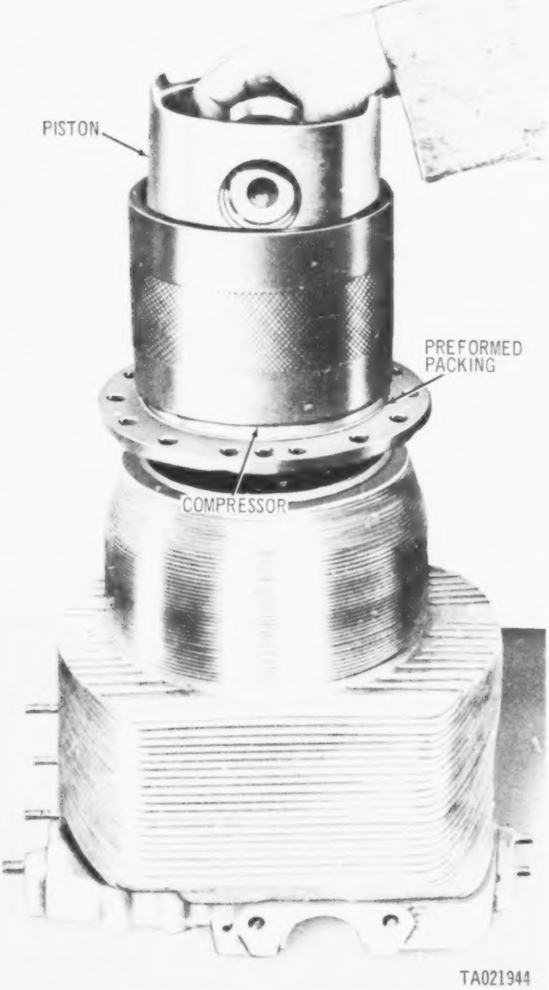


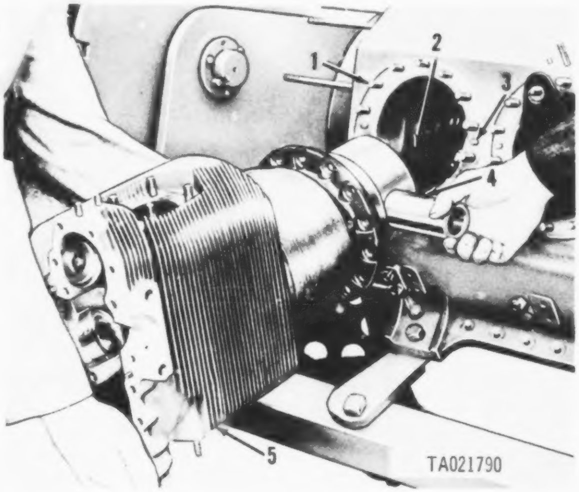
Figure 3-318. Installing piston in cylinder assembly using compressor and gage.

e. Install new preformed packing (fig. 3-318) on each cylinder base making sure that packing is not twisted or other wise improperly seated.

CAUTION

Lubricant must extend across face of washer nut in order to obtain reliable torque.

f. Sparingly coat cylinder stud threads (1, fig. 3-319) on crankcase with OE engine oil or GAA grease.



1 Mounting stud
2 Connecting rod
3 Dowel pin
4 Piston pin
5 Cylinder assembly

Figure 3-319. Installing cylinder assembly and piston.

g. Using splined wrench 10882747, rotate engine crankshaft until the No. 1R connecting rod (2) is at the top of its stroke. Remove crankcase protector 10882790 from cylinder No. 1R mounting studs (1) being careful not to allow connecting rod to forceably drop against the crankcase cylinder mounting surface or mounting studs.

g.1. Install power take-off drive coupling (1, fig. 2-148.2) on spur gearshaft and secure with flat washer (4) and self-locking nut (3). Install holding bar and puller assembly on coupling (fig. 2-148.2). Rotate engine crankshaft until the No. 1R connecting rod (2, fig. 3-319) is at the top of its stroke. Remove crankcase protector, part number 10882790, from cylinder No. 1R mounting studs (1). Do not allow connecting rod to come in contact with the crankcase cylinder mounting surface or mounting studs.

h. Remove piston pin from piston of No. 1R cylinder assembly and place piston and cylinder over No. 1R connecting rod. Insert piston pin(4) through connecting rod and piston and center pin in position. Install a piston pin retaining ring in groove in piston at each end of piston pin. Slide cylinder (5) over piston on crankcase studs and temporarily secure with two extended washer nuts (fig. 3-103) positioned approximately 180 degrees apart.

i. When all cylinder assemblies are installed as described and illustrated in figure 3-319, install remaining cylinder extended washer nuts and torque tighten the nuts alternately to 640 pound-inches. Use box wrench 8761562 in combination with a torque wrench as shown in figure 3-102.

i.1. Hold holding bar and puller assembly (fig. 2-148.2) to prevent crankshaft from turning, and remove self-locking nut (3) and flat washer (4). Remove holding bar and puller assembly. Install holding bar and puller assembly (fig. 2-148.3) on power takeoff drive coupling (1) with boss against gearshaft, and secure with two 7/16-20UNF x 1 ½-inch capscrews (2). Alternately tighten the two capscrews and remove the power takeoff drive coupling. Remove holding bar and puller assembly.

j. Install all cylinder deflectors (fig. 3-101) except deflectors at outside of cylinder Nos. 1R, 1L, 6R and 6L on cylinder assemblies. Install the ten lower cylinder deflector straps and the ten lower cylinder deflector retaining straps (fig. 3-100) and secure the lower cylinder strap on each side of the engine with ten bolts.

k. Install five preformed packings on oil transfer tubes of crankcase as shown in figure 3-99. Using a suitable chain or hoist (fig. 3-98) at the crankshaft damper and oil filter housing lifting eyes, install the housing assembly on the crankcase assembly, and secure with eight self-locking nuts and flat washers.

l. Apply a thin coat of gasket cement, Specification MIL-C-10523 (ORD), on the oil pan flange and install sealing thread (fig. 3-320). Apply a 1/16 to 1/8 inch bead of Specification MIL-A-46106 adhesive sealant at the split line (fig. 3-320.1) on the bottom flange of the damper housing and crankcase assembly. Support the oil pan adequately and position oil pan on crankcase assembly. Install one self-locking nut and washer on each side of the oil pan to prevent pan from falling when engine is rotated to upright position. Secure oil pan (4, fig. 3-97) to each side of the crankcase assembly with 27 self-locking nuts and flat washers (3) and to the crankshaft damper and oil filter housing (2) with nine capscrews, lockwashers and flat washers (1). Secure oil pan to rear of crankcase assembly with eight capscrews, lockwashers and flat washers (fig. 3-96). Torque tighten oil pan bolts to 175 pound-inches. On model AVDS-1790-2DR, install pipe elbow (6, fig. 3-97.1), bushing (5), nipple (7), tee (4), pipe elbow (3), auxiliary generator high oil pressure switch (2), and high oil pressure transmitter (1).

m. (Model AVDS-1790-2C only) Install generator oil inlet hose adapter (4, fig. 3-94) and connect generator oil inlet hos (3). Install generator oil drain hose adapter (2) and connect generator oil drain hose (1).

n. Rotate engine stand, as shown in figure 3-321 and cover all cylinder and engine openings with plastic covers or suitable improvised covers. Cover twelve cylinder exhaust ports (2, fig. 3-321) twelve injector nozzle holder assembly ports (1) and starter adapter opening (6). Cover oil filler and oil level indicator openings (5) and cylinder head oil drain tube openings (4). Cover oil cooler inlet and outlet hose opening (3) on each side of crankcase damper and oil filter housing.

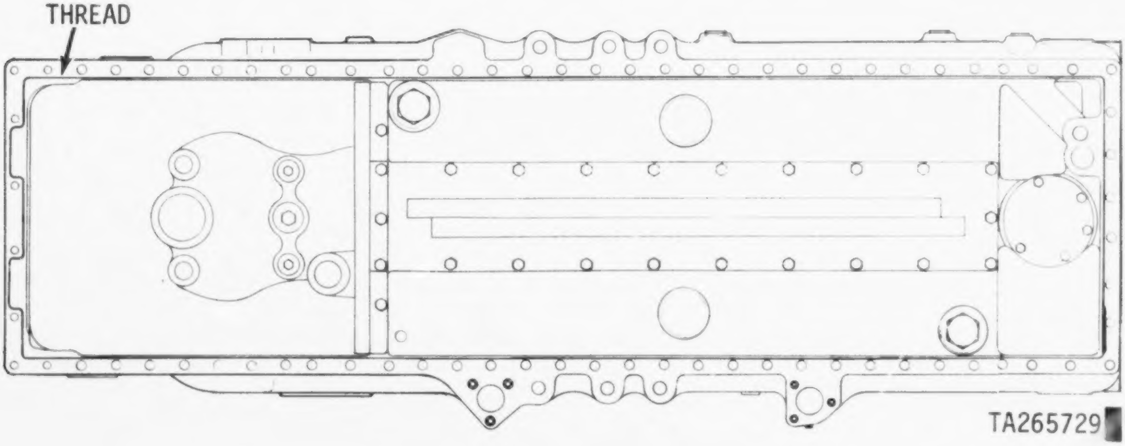


Figure 3-320. Installing oil pan sealing thread.

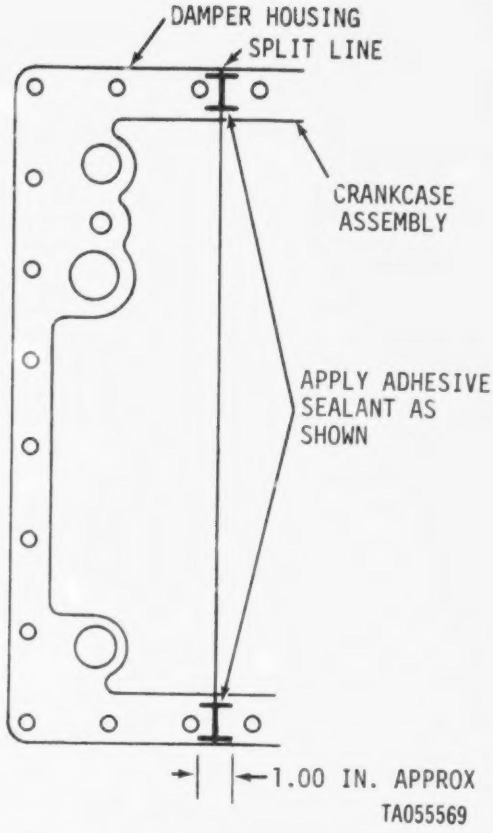


Figure 3-320.1. Bottom flange of damper housing and crankcase showing sealant application.

3-165. Rear Fan and Accessory Drive Housing with Clutch Assembly and Mounting Base

a. Install three new preformed packings on oil transfer tubes in crankcase (fig. 3-93). Apply a thin coat of sealing compound (MIL-S-45180 ORD) to mounting base (3, fig. 3-92) lower mounting surface and install mounting base on crankcase assembly and secure with six capscrews and flat washers (2) and ten slotted nuts and flat washers (1). Torque tighten screws and nuts to 275 pound-inches and install ten cotter pins in slotted nuts. Install four new preformed packings (4) in oil transfer counterbores and apply a thin coat of sealing compound (MIL-S-45180 ORD) on mounting surface of base prior to assembling rear fan and accessory drive housing.

b. Remove top two self-locking nuts and flat washers (3, fig. 3-89) to provide for the attachment of fan and advance unit housing sling part number 10882945 (fig. 3-90). Install sling on rear fan drive housing and clutch assembly and secure with two self-locking nuts and flat washers (3, fig. 3-89). Secure lifting sling to fan vertical drive shaft with fan slotted nut (fig. 3-90). Adjust lifting eye in slot to assure balanced position of the assembly during installation.

c. Lower the rear fan and accessory drive housing (fig. 3-322) until holes in housing aline with studs in mounting base. Continue lowering housing until accessory drive bevel gearshaft teeth engage with gear teeth of accessory drive gear. After rear fan and accessory drive housing are positioned remove slotted nut attaching housing sling to vertical drive shaft. Remove two self-locking nuts and flat washers (3, fig. 3-89) and remove sling.

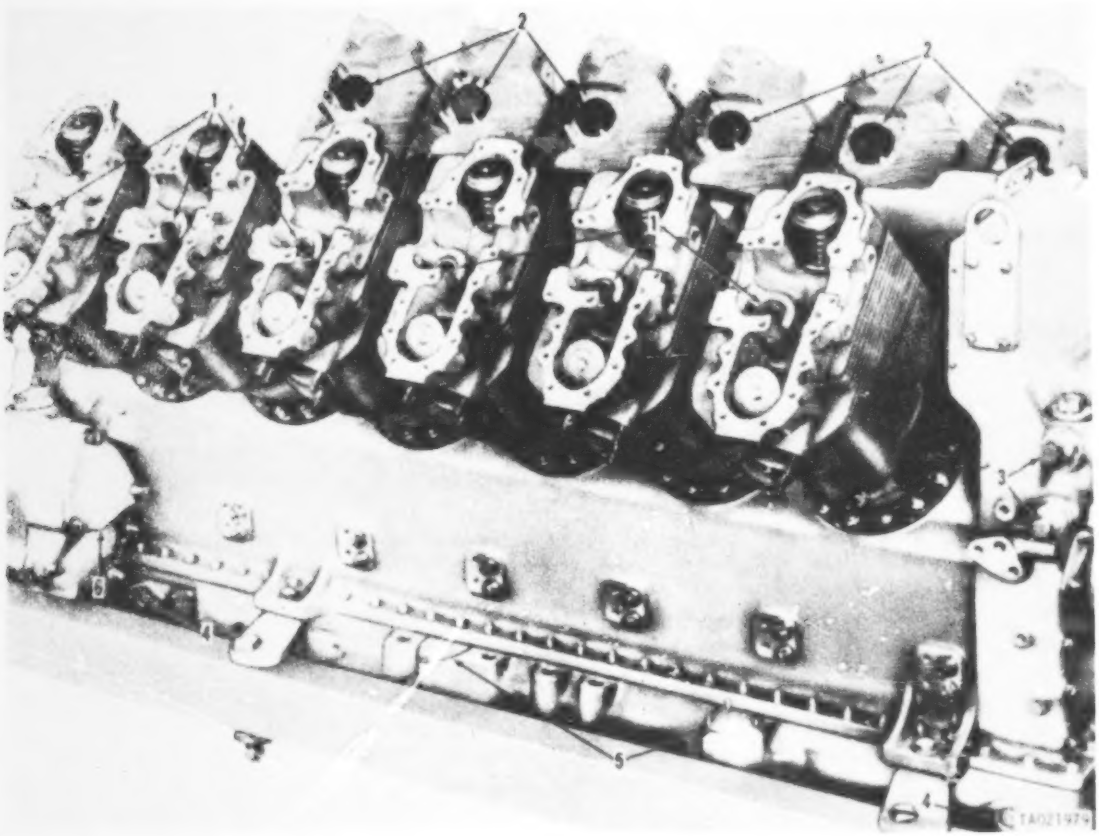
d. Install one self-locking nut and flat washer (5, fig. 3-89) on each side of the drive housing mounting base flange. One self-locking nut will be installed at stud (4) when fire extinguisher tube is installed. Install two self-locking nuts and flat washer (3) using for the attachment of fan and advance unit sling, part number 10882945. Secure the rear fan and accessory drive housing assembly to the left side of the mounting base with 11 self-locking nuts and flat washers (1). Install self-locking nut, flat washer and seal washer (2). Torque tighten 11 nuts to 275 pound-inches. Secure the rear fan and accessory drive housing assembly to the right side of the mounting base with 13 self-locking nuts and flat washers (fig. 3-88). Install one self-locking nut, flat washer and seal washer (fig. 3-88). Torque tighten nuts to 275 pound-inches.

3-166. Fuel Injection Pump Mounting Base

Install new preformed packing at oil transfer tube in crankcase assembly (fig. 3-87). Install fuel injection pump mounting base on crankcase assembly and secure with four bolts and lockwashers (fig. 3-86) and torque tighten to 750 pound-inches. Install a new preformed packing on oil transfer tube on mounting base.

3-167. Front Fan Drive Housing with Clutch Assembly and Mounting Base

a. Install a new preformed packing at oil transfer tube in crankcase assembly (fig. 3-85). Apply a thin coat of sealing compound (MIL-S-45180 ORD) on the mounting base lower mounting surface. Install front fan drive housing mounting base assembly (4, fig. 3-84) on crankcase assembly and secure with two capscrews and flat washers (2) and ten slotted nuts and flat washers (1). Torque tighten slotted nuts and capscrews to 275 pound-inches and secure nuts with ten cotter pins. Install a new preformed packing (3) in oil transfer tube counterbore in mounting base assembly.



1 Nozzle holder assembly port
2 Cylinders exhaust port
3 Oil cooler inlet and outlet hose opening
4 Drain tube opening
5 Oil filler and oil level indicator openings
6 Starter adapter opening

Figure 3-321. Protecting openings to prevent entrance of dust and foreign objects.

b. Position cover adapter (16, Fig. 3-230) on front fan drive shaft cover (15). Similarly, position adapter (24) on rear fan drive shaft cover (25). Join the two shaft covers (15 and 25) using rubber hose (20) and two hose clamps (19 and 21). Tighten hose clamps just enough to hold the covers together as a unit. Install a preformed packing (14 and 26) on adapter end of each shaft cover. Install retaining ring (13) on front fan drive shaft (12).

NOTE

Do not install retaining ring in groove located on the front spline. Ring must be located beyond the spline at this time.

c. Install front fan drive shaft with retaining ring in front fan drive bevel gearshaft (21, fig. 3-216) of front fan drive housing and clutch assembly. Long spline must enter gearshaft. Install the assembled drive shaft covers over the front fan drive shaft with short housing toward front fan drive housing as shown in figure 3-323.

d. Install improvised front fan drive housing lifting tool (fig. 2-1) on vertical drive shaft (fig. 3-323). Apply light coat of sealing compound (MIL-S-45180 ORD) on mounting base and lower front fan drive housing assembly and associated parts on mounting base.

e. Secure front fan drive housing to mounting base with two drilled head capscrews and flat washers (fig. 3-82) and secure with locking wire. Install nine self-locking nuts and flat washers (fig. 3-81) when fire extinguisher tube is installed.

f. Push fan drive shaft to the rear to fully engage the spline in the rear fan drive bevel gearshaft. Using retaining ring pliers part number GGG-P-480A-Type II, Class 3, Style B, Size 22 install retaining ring in fan drive shaft spline groove (fig. 3-78). Secure front horizontal fan drive shaft cover adapter to front fan drive housing with two self-locking nuts and flat washers (fig. 3-76). Secure rear cover adapter to rear drive housing with two self-locking nuts and flat washers. Center hose on drive shaft housings and tighten two hose clamps.

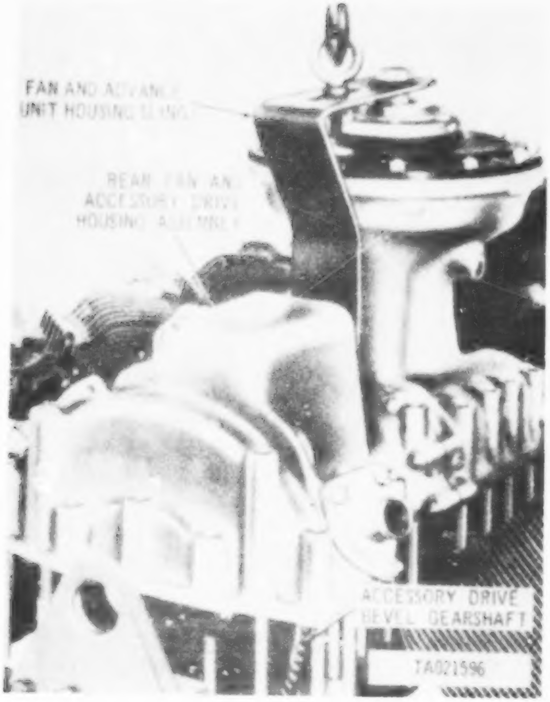

FAN AND ADVANCE
UNIT HOUSING SLING
REAR FAN AND
ACCESSORY DRIVE
HOUSING ASSEMBLY
ACCESSORY DRIVE
BEVEL GEARSHAFT
TA021596

Figure 3-322. Installing rear fan and accessory drive housing using fan and advance unit housing sling.

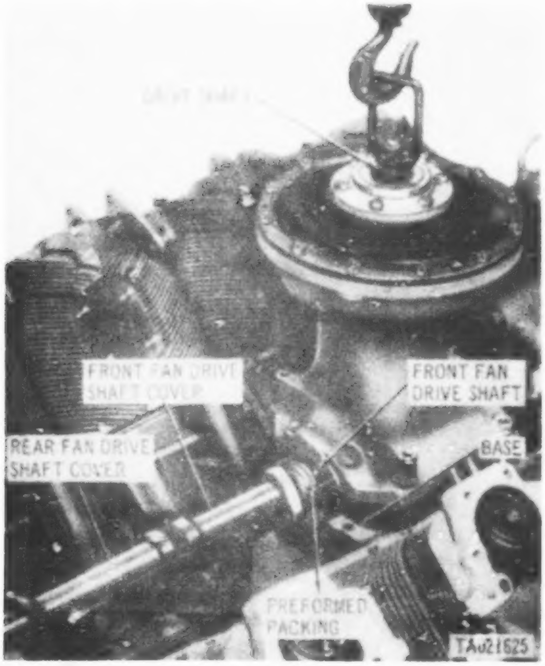

DRIVE SHAFT
FRONT FAN DRIVE
SHAFT COVER
FRONT FAN
DRIVE SHAFT
REAR FAN DRIVE
SHAFT COVER
BASE
PREFORMED
PACKING
TA021525

Figure 3-323. Installing front fan drive housing assembly using improvised lifting tool.

3-168. Camshafts and Valve Timing

NOTE

Both the left and right camshafts are installed in the same manner. For instructional purposes, the right camshaft has been used for typical procedures.

a. Refer to figure 3-75 and install camshaft on bearings on cylinder heads. Attach camshaft gear housing to cylinder 6R with two capscrews, flat washers and lockwashers (fig. 3-74), but do not tighten capscrews at this time. Tighten two hose clamps.

b. Rotate crankshaft until timing mark "6R INT CLOSE .100 CLR" on flywheel alines with pointer (fig. 3-324) using splined wrench, part number 10882747, (fig. 3-325).

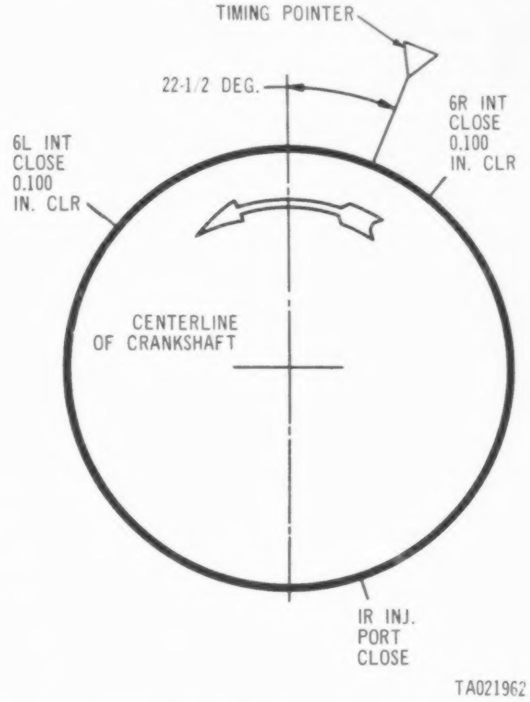

TIMING POINTER
22-1/2 DEG.
6R INT
CLOSE
0.100
IN. CLR
6L INT
CLOSE
0.100
IN. CLR
CENTERLINE
OF CRANKSHAFT
IR INJ.
PORT
CLOSE
TA021962

Figure 3-324. Flywheel timing mark location, model AVDS-1790-2C and AVDS-1790-2D engines.

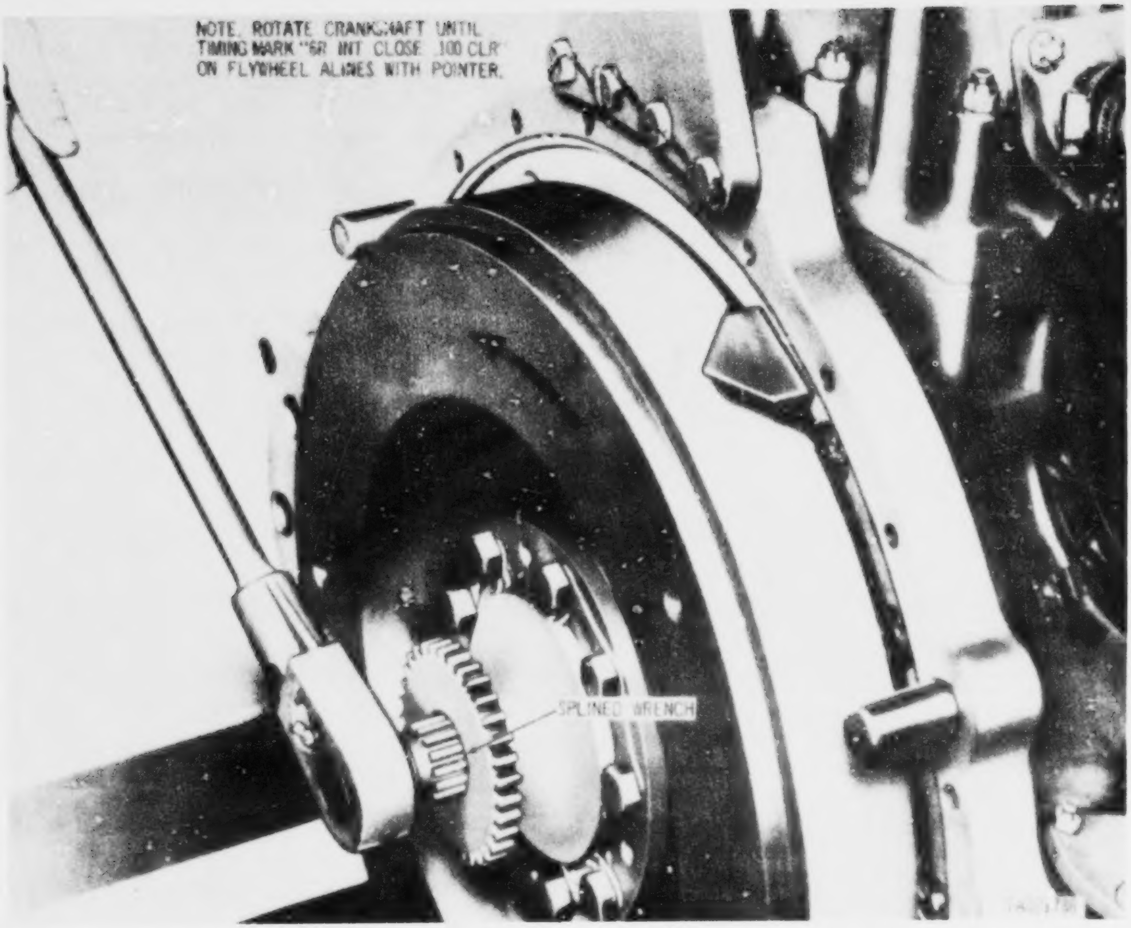
b.1. Install power take-off drive coupling (1, fig. 2-148.2) on spur gearshaft and secure with flat washer (4) and self-locking nut (3). Install holding bar and puller assembly on coupling (fig. 2-148.2).

NOTE

Valve rocker arm covers for cylinder Nos. 2R through 5R are not installed until the engine is timed.

NOTE

The valve timing procedure must be followed in detail to prevent the valves from striking the head of the piston.



NOTE. ROTATE CRANKSHAFT UNTIL TIMING MARK "6R INT CLOSE .100 CLR" ON FLYWHEEL ALINES WITH POINTER.

Figure 3-325. Positioning engine flywheel, model AVDS-1790-2C and AVDS-1790-2D engines.

c. Rotate the right camshaft (fig. 3-326) until the two lobes (cams) for the intake and exhaust valves for No. 6R cylinder are pointed towards the crankshaft. Remove cover from fuel injector nozzle holder assembly opening in cylinder.

d. Apply a light film of sealing compound (MIL-S-45180 ORD) on valve rocker arm cover and position cover on cylinder. Identifying numbers on cover and cylinder must correspond (fig. 3-64). Valve rocker arm rollers must contact base circle of camshaft and lip of preformed intercylinder hoses must not be folded under cover. Tap cover gently to position cover over dowel pins.

e. Install four new packings with retainers on four bolts (fig. 3-326) and install the four bolts and torque tighten to 275 to 325 pound-inches. Secure rocker cover to cylinder head with two capscrews and flat washers (3, fig. 3-67) seven bolts and flat washers (2) and four bolts and flat washers (1). Torque tighten eleven bolts and two capscrews to 100 pound-inches.

f. Secure camshaft gear housing to valve rocker arm cover with one capscrew, flat washer and lockwasher (1, fig. 3-66) and to cylinder head by tightening two capscrews, flat washers and lockwashers (2) installed above.

g. Using thickness gage blade part number 10882617 (fig. 3-326) set intake valve clearance to 0.100 inch by turning the adjusting screw clockwise to decrease the clearance or counterclockwise to increase the clearance. Check position of valve adjusting screw pad to make sure seat is flat on valve stem.

h. Using thickness gage blade part number 10882616 (fig. 3-327) set exhaust valve clearance to 0.025 in. by turning the adjusting screw clockwise to decrease the clearance or counterclockwise to increase the clearance. Check position of valve ad-

best copy available

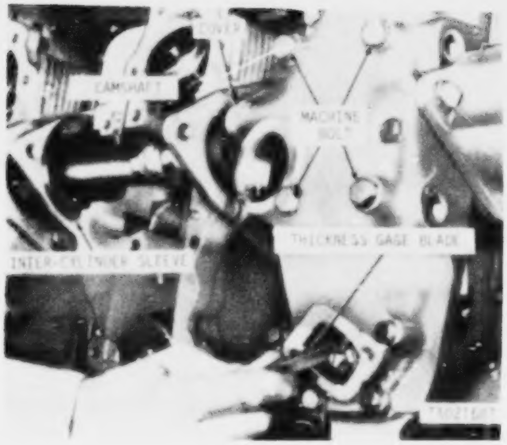


Figure 3-326. Installing valve rocker arm cover and adjusting intake valve clearance (cylinder No. 6R).

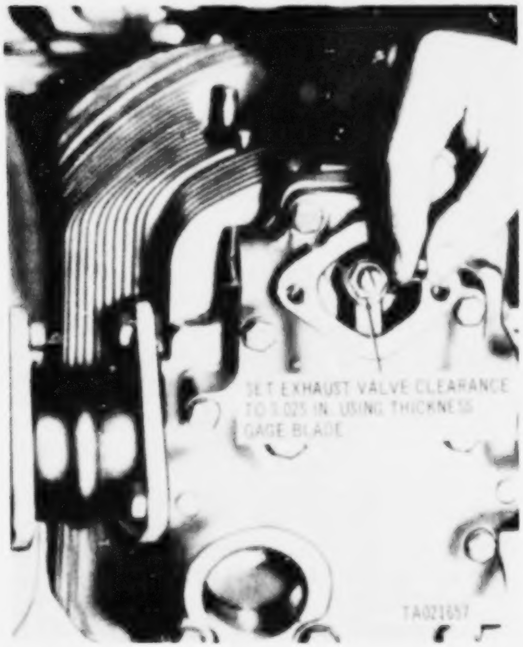

SET EXHAUST VALVE CLEARANCE TO 0.025 IN. USING THICKNESS GAGE BLADE
TA021657

Figure 3-327. Adjusting exhaust valve-clearance.

justing screw pad to make sure seat is flat on valve stem and torque tighten adjusting screw lock nut to 175 pound-inches.

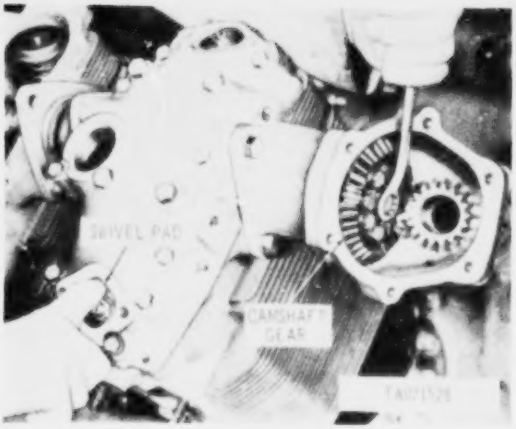


Figure 3-328. Determining closing point of No. 6 intake valve.

i. Slowly turn camshaft (fig. 3-328) clockwise, as viewed from flywheel end, until No. 6R intake valve has just closed. Closing point is determined by trying to rotate the swivel pad on the intake valve adjusting screw while the camshaft is being rotated. The valve is closed the instant the swivel pad is free to move.

NOTE

> Do not force camshaft drive. The shaft is machined with a 24-tooth spline on inner end, and a 28-tooth spline on outer end. This difference in number of teeth provides a vernier effect which makes it possible to index the drive shaft so it will engage the splines of the camshaft drive gearshaft and camshaft drive bevel gearshaft at some point within 360 degrees. An accurate setting is then provided without changing the relationship of the camshaft and crankshaft.

j. Maintain the position of camshaft as set in figure 3-328 and the crankshaft position set in figure 3-325. Insert camshaft drive shaft (fig. 3-329) using mechanical puller part number 8761297, and mate splines on drive shaft with splines in camshaft drive bevel gearshaft. When splines of drive shaft do not mate with splines of camshaft gearshaft, withdraw drive shaft and turn slightly before again attempting insertion.

NOTE

> It may be necessary to repeat this operation a number of times before splines will mate and allow drive shaft to be inserted into position.

k. Check valve timing by rotating crankshaft clockwise as viewed from rear, approximately 1/8 turn to remove gear backlash, then turn counterclockwise until the valve is just closed. Stop rotating the crankshaft the instant the swivel pad becomes free. Observe position of flywheel timing mark. When timing mark on flywheel is alined within 1/8 inch of the timing pointer, the valve

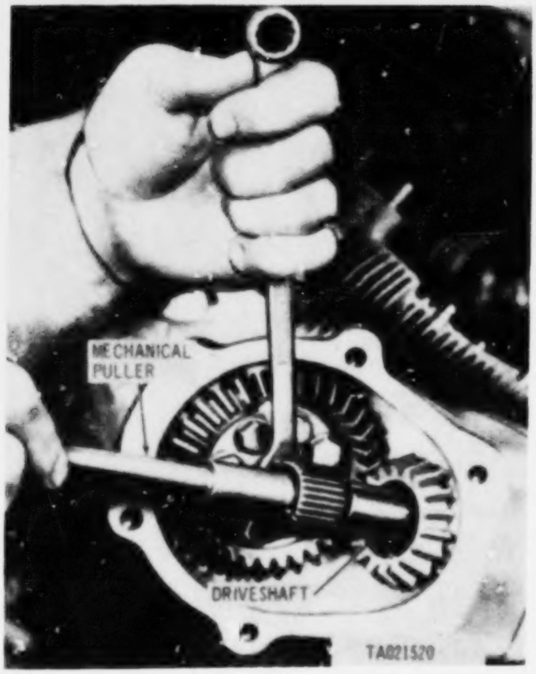


Figure 3-329. Installing camshaft drive shaft.

timing is correct. When timing mark is not alined, withdraw camshaft drive shaft, and repeat timing procedure and again check valve timing. When correct valve timing is obtained, install right oil transfer plug (fig. 3-330) using mechanical puller part number 8761297 and install camshaft drive gearshaft oil transfer plug retaining ring.

NOTE

When correct timing cannot be obtained as described above, it may be necessary to set timing mark 1/8 to 1/4-inch out of alinement before installing drive shaft.

l. Set cylinder No. 6R intake valve clearance by rotating crankshaft counterclockwise approximately 1/4 turn in order to have No. 6R intake valve rocker arm roller on base circle of camshaft. Set intake valve clearance to final 0.010-inch setting, using thickness gage blade part number 10882615 as shown in figure 3-326. Torque tighten adjusting screw lock nut to 175 pound-inches after adjustment.

m. Rotate the crankshaft counterclockwise approximately 270 degrees from "6R INT CLOSE 0.100 CLR" until flywheel timing mark "6L INT CLOSE 0.100 CLR" is alined with timing pointer. Install the left camshaft and No. 6L valve rocker cover following same procedure as outlined for right camshaft and No. 6R valve rocker cover.

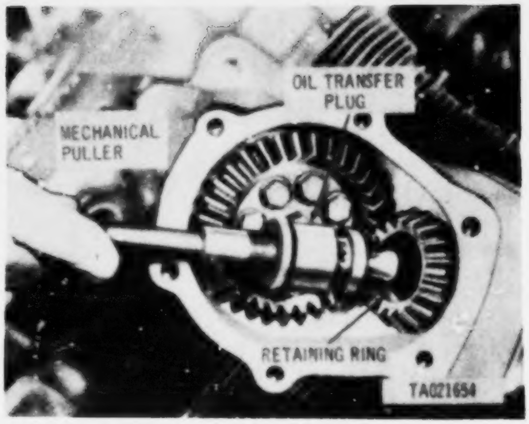


Figure 3-330. Installing right camshaft oil transfer plug.

n. Install new gaskets and camshaft gear housing covers (fig. 3-70) on each camshaft gear housing and secure each cover with bolts and flat washers.

3-169. Fuel Injection Pump and Timing

a. Install woodruff key and injection pump coupling half on pump shaft and secure with lockwasher and plain nut (fig. 2-45). Insert a hardened steel rod in one of the sleeve alinement holes, torque tighten plain nut to 900 pound-inches. Install a new preformed packing in groove in face of coupling sleeve. Use a light coating of grease to hold preformed packing in position.

b. Remove fuel injection pump timing hole plug (fig. 2-47). Turn injection pump shaft with drive coupling until marked gear tooth is visible in timing hole (fig. 2-48).

NOTE

It is possible to have the timing mark on the coupling alined with mark on the injection pump bearing retaining plate (fig. 2-49) and not have the marked gear tooth visible in timing hole. Make sure marked tooth (fig. 2-48), is visible when timing marks are alined. If the marked tooth is not visible, rotate the pump shaft 360 degrees in either direction. Aline the coupling timing marks and the marked tooth will be visible in the timing hole. Install timing hole plug.

CAUTION

Timing pointer must aline with correct timing mark on flywheel.

c. Turn engine flywheel (fig. 2-51), using splined wrench part number 10882747 and aline "1R INJ PORT CLOSE" timing mark on flywheel with timing pointer. If camshaft lobes are not in the position shown in figure 3-331, rotate engine crankshaft 360 degrees and the camshaft lobes will be in the position shown in figure 3-331.

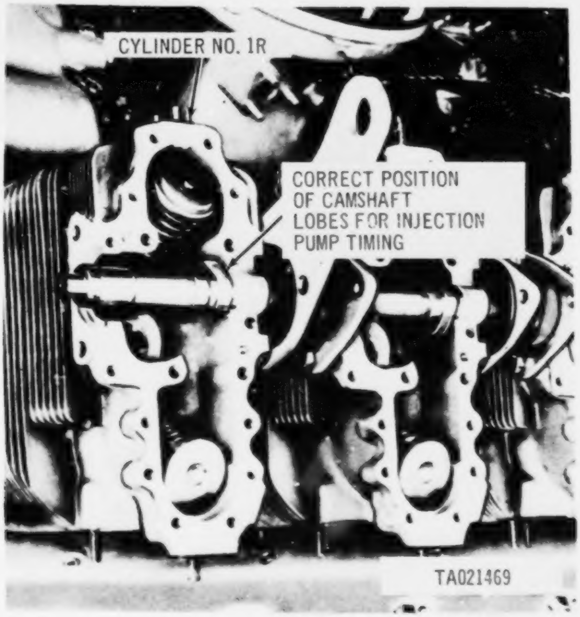

CYLINDER NO. 1R
CORRECT POSITION OF CAMSHAFT LOBES FOR INJECTION PUMP TIMING
TA021469

Figure 3-331. Correct position of cylinder 1R camshaft lobes (cams) for fuel injection pump installation – installed view.

c.1. Turn crankshaft using holding bar and puller assembly (fig. 2-148.2) and aline "1R INJ PORT CLOSE" timing mark on flywheel with timing mark on transmission housing adapter (fig. 2-51.1). If camshaft lobes are not in the position shown in figure 3-331, rotate engine crankshaft 360 degrees and the camshaft lobes will be in the position shown in figure 3-331.

d. Push drive coupling sleeve toward rear fan and accessory drive housing, until sleeve clears splined hub. Rotate coupling sleeve until identification marks approximate the correct position to mate with injection pump drive coupling sleeve identification marks (fig. 2-53).

NOTE

> Fuel injection pump lower right mounting bolt and plain washer (fig. 2-44) must be inserted in injection pump before pump is seated on mounting base. The bolt cannot be installed with pump in position.

e. Install bolt and plain washer (5, fig. 3-56) in pump housing. Install pump (6) with mounting bolt and plain washer on mounting base and install three bolts and plain washers (4). Torque tighten the four bolts to 600 pound inches and install locking wire.

f. Position fuel injection pump coupling sleeves making sure timing marks on bearing retaining plate and coupling hub remain alined. These marks must be alined before attempting to assemble the coupling. Loosely install four lock plates, lockwasher, and bolts in drive shaft coupling sleeves (fig. 2-43). Insert two 5/16 in. steel rods in sleeve alinement holes (fig. 2-54). Hold fuel injection pump drive coupling sleeve (nearest the pump) stationary and rotate the other drive coupling sleeve counterclockwise to remove backlash from the pump drive shaft. When backlash is removed and flat sides of drive coupling are alined, tighten four drive coupling bolts securely. When flat sides of drive coupling sleeves do not mate when backlash is removed, the coupling sleeves must be separated and reset. Separate coupling and push sleeve of drive coupling on rear fan and accessory drive housing shaft toward drive shaft and from hub splines. Adjust sleeve on splines so flat sides of coupling halves are alined. Torque tighten coupling bolts to 375 - 425 pound-inches.

g. Remove two pipe plugs from coupling and install 1/16 - 27 inch lubrication fitting (fig. 2-55) in one hole and lubricate coupling with MIL-G-81322 grease. Discontinue adding lubrication when grease shows in the open hole on opposite side of coupling. Over filling cavity will result in failure of coupling seals. Remove lubrication fittings and install the pipe plugs (fig. 2-54).

NOTE

> For instructional purposes, installation of rocker arm cover for cylinder No. 1R is used. Remaining covers are installed in the same manner.

h. Rotate the crankshaft until the two camshaft lobes (cams) for the intake and exhaust valves for No. 1R cylinder are pointed towards the crankshaft (fig. 3-331 and fig. 3-332). Remove protective cover from fuel injector nozzle holder assembly opening in cylinder assembly.

i. Apply a light film of sealing compound (MIL-S-45180 ORD) on valve rocker arm cover and install cover on cylinder. Identifying numbers on cover and cylinder must correspond (fig. 3-64). Valve rocker arm rollers must contact base circle of camshaft and lip of preformed intercylinder hoses must not be folded under cover. Tap cover gently to position cover over dowel pins.

j. Install four new packings with retainers on four bolts (fig. 3-326) and install the four bolts and torque tighten to 275 to 325 pound-inches. Secure rocker cover to cylinder head with two capscrews and flat washers (3, fig. 3-67) seven bolts and flat washers (2) and four bolts and flat washers (1). Torque tighten eleven bolts and two capscrews to 100 pound-inches.

k. Using thickness gage blade part number 10882615 as shown in figure 3-326, set intake valve

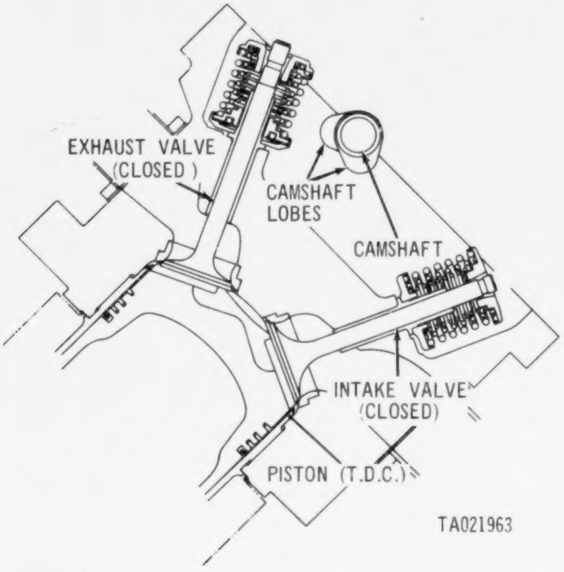


Figure 3-332. Correct position of camshaft lobes (cams) for fuel injection pump installation – sectional view.

clearance to 0.010 inch by turning the adjusting screw clockwise to decrease the clearance or counterclockwise to increase the clearance. Check position of valve adjusting screw pad to make sure seat is flat on valve stem and torque tighten adjusting lock nut to 175 pound-inches.

l. Using thickness gage blade part number 10882616 as shown in figure 3-327, set exhaust valve clearance to 0.025 in. by turning the adjusting screw clockwise to decrease the clearance or counterclockwise to increase the clearance. Check position of valve adjusting screw pad to make sure seat is flat on valve stem and torque tighten adjusting screw lock nut to 175 pound-inches.

m. Rotate crankshaft as necessary to position camshaft lobes (cams) in downward position (figs. 3-331 and 3-332) as each of the remaining valve rocker arm covers are installed.

n. Loosely install all camshaft preformed hose flange bolts (fig. 3-333). Slide a piece of shim stock between the lip of the preformed intercylinder hose and the mating faces of the valve rocker arm cover and cylinder to remove any possible creases. Tighten the flange bolts.

NOTE

Do not damage lip of preformed intercylinder hose. Any defect will be a source of an oil leak.

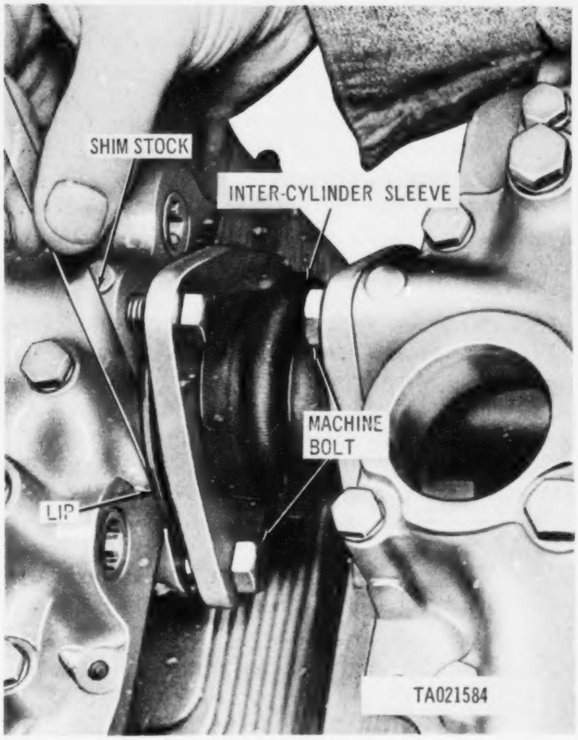


Figure 3-333. Installing camshaft intercylinder hose flange bolts.

o. Install two new cover plate gaskets (5, fig. 3-63) on each of 12 rocker arm covers. Install 24 valve adjusting screw cover plates (3) on rocker arm covers and 12 injector tube clamp supports (2) on cover plates at locations shown in figure 3-45. Secure supports and plates to covers with 24 bolts and flat washers (washers under supports (1, fig. 3-63). Secure cover plates to rocker arm covers with 24 bolts and flat washers (4).

3-170. Fuel Injector Nozzle and Holder Assembly

a. Install new preformed packings (fig. 2-86) on fuel injector nozzle holder. Apply a thin coating of grease on the flat washer (gasket) (fig. 2-86) to retain gasket in position and install gasket on nozzle assemblies.

b. Install fuel injector nozzle and holder assemblies using crow-foot attachment (wrench) (part number 11610167). Torque tighten to 500 pound-inches after connecting the fuel injector tube to the nozzle.

3-171. Shroud Plates and Cylinder Deflectors

a. Install five right intercylinder deflectors (fig. 3-61) and five intercylinder deflector hooks. Install left intercylinder hooks and deflectors in the same manner. Secure the hooks with ten self-locking nuts and flat washers (fig. 3-60).

b . Install five right intercylinder head deflectors and hooks (fig. 3-60) and five left intercylinder head deflectors and hooks and secure with ten self-locking nuts and washers.

c. Install spring clip on lower right rear of crankcase and secure with machine screw and lock washer (fig. 3-59). Install lower right rear engine shroud on engine and engage spring clip. Install cylinder base shroud on engine shroud and secure with two machine screws. Install 6R cylinder baffle and secure to lower right rear engine shroud with machine screw (fig. 3-58). Install left lower shroud, base shroud and clip, and cylinder baffle in the same manner.

d. Install upper right camshaft drive shroud (fig. 3-57) on engine and secure to lower right rear engine shroud with machine screw. Install lower right camshaft drive shroud on engine and secure to upper right camshaft shroud and lower right engine shroud with two machine screws. Install left camshaft drive shrouds in the same manner.

3-172. Throttle Control, Fuel Shutoff Rod and Throttle Lever

a. Install lever support, shaft and intermediate lever (3, fig. 3-55), as an assembly, and return spring bracket (8) on front fan drive housing and secure with three self-locking nuts (7).

*a.*1. Install intermediate throttle lever support (8, fig. 3-55.1), shaft and throttle lever and secure with three self-locking nuts and flat washers (7).

b. Connect throttle lever return spring (6, fig. 3-55) to return spring bracket (8) and intermediate throttle lever (3). Install throttle adjustable rod (5) on intermediate throttle lever and secure with self-locking nut and machine bolt (4). Install throttle rod (2) on intermediate throttle lever and on injection pump and secure with two self-locking nuts, machine bolt, and one flat washer (1).

b.1. Install throttle rod (5, fig. 3-55.1) and secure to intermediate throttle lever with one self-locking nut, machine bolt and flat washer (4). Connect throttle rod to fuel injection pump lever and secure with self-locking nut, machine bolt and flat washer (3). Install adjustable rod (2) and secure with one self-locking nut and machine bolt (1).

c. Install shut off spring bracket (4) fig. 3-54 on fuel injection pump and secure with two capscrews (5). Connect manual fuel shut-off spring (3) to spring bracket and injection pump lever. Install manual fuel shut-off rod (2) on injection pump lever and secure with flat washer and new cotter pin (1).

c.1. Install spring bracket (4, fig. 3-54.1) on fuel injection pump and secure with three capscrews and lockwashers (5). Connect manual fuel shut-off rod (2) to fuel injection pump lever and secure with one cotter pin and flat washer (1). Install manual fuel shut-off rod spring (3) on bracket and lever.

3-173. Turbosupercharger Base, Supports, and Tie Rod

a. Install right turbosupercharger mounting base support on transmission adapter and secure with slotted nut, bolt and cotter pin (fig. 3-53). Install left support in the same manner.

*a.*1. Install right turbosupercharger mounting base support on transmission adapter and secure with slotted nut, bolt and cotter pin (fig. 3-53). Install left support in a similar manner except also install the oil filler tube upper support (fig. 3-53.1).

b. Install tie rod clamp seat and turbosupercharger tie rod on transmission adapter and secure seat and tie rod to transmission adapter with tie rod clamp, two capscrews and lockwashers. Install left and right turbosupercharger mounting bases on tie rod and mounting base supports and secure with four capscrews and lockwashers (fig. 3-53).

3-174. Fuel Injection Pump Oil Inlet Hose, Turbosupercharger Oil Inlet Hose, and Fire Extinguisher Tube

a. Install cushioned clamp on fire extinguisher tube (8, fig. 3-52) and install tube on engine. Install turbosupercharger oil inlet hose elbow (10) in damper and filter housing. Install cushioned clamp on turbosupercharger oil inlet hose (9) and connect hose to elbow in damper and filter housing.

*a.*1. Install cushioned clamp (9, fig. 3-52.1) on fire extinguisher tube and install tube on engine. Install cushioned clamp on turbosupercharger oil inlet hose (10), and connect hose to elbow in damper and filter housing.

b. Position cushioned clamp (1, fig. 3-52) on fire extinguisher tube (8) as shown and aline with clamp on oil inlet hose and secure clamps to front fan drive housing with self-locking nut. Connect fuel injection pump oil inlet hose (7) at damper housing and at injection pump.

*b.*1. Position cushioned clamp on fire extinguisher tube as shown in figure 3-52.1 and aline with clamp on oil inlet hose and secure clamps to front fan drive housing with self-locking nut. Connect fuel injection pump oil inlet hose (8) at damper housing and at injection pump.

3-175. Fuel Inlet and Return Hose and Crankcase Breather Tube

a. Install a new breather tube adapter gasket on crankshaft damper and filter housing. Install breather tube adapter (6, fig. 3-52) on housing and secure with two self-locking nuts. Install crankcase breather tube with clamps and hose, tighten hose clamp (5) securing breather tube to adapter. Connect fuel inlet hose (4) and the electrical lead (2) at the fuel injection pump. Install two cushioned clamps on the fuel inlet hose (4), three cushioned clamp on the crankcase breather tube (3) and three cushioned clamps on the electrical lead (2). Position clamps as shown in figure 3-52 and secure with three screws and self-locking nuts.

a.1. Install a new breather tube adapter gasket on crankshaft damper and filter housing. Install breather tube adapter (7, fig. 3-52.1) on housing and secure with two self-locking nuts. Install crankcase breather tube with hose and hose clamps (6). Connect fuel inlet hose (4) and electrical lead (3) at the fuel injection pump. Install two cushioned clamps (5) on electrical lead (3) and breather tube. Install six cushioned clamps (2) securing electrical lead (3) and fuel injection pump fuel inlet hose (4) to the breather tube. Secure clamps with two self-locking nuts and machine screws. Install two cushioned clamps (1) securing fuel return hose to the breather tube.

b. Install cushioned clamp (6, fig. 3-51) on turbosupercharger oil inlet hose (10) and cushioned clamp (7) on fire extinguisher tube and secure clamps to rear fan drive housing with self-locking nut. Install cushioned clamp (5) on crankcase breather tube (9) and secure to rear fan drive housing with self-locking nut and flat washer. Install fuel return check valve (4) in elbow in the injection pump and connect fuel return hose (3) to the check valve. Install cushioned clamp (2) on fuel return hose and cushioned clamp (1) on turbosupercharger oil hose, position clamps as shown in figure 3-51 and secure with screw and self-locking nut.

b.1. Install turbosupercharger oil hose cushioned clamp (1, fig. 3-51.1) and fuel return hose cushioned clamp (2) and secure with one machine screw and self-locking nut. Connect fuel return hose (3) to elbow in fuel return check valve (4). Install fuel return hose cushioned clamp (5) and breather tube cushioned clamp (6) and secure with one machine screw and self-locking nut. Install fire extinguisher tube cushioned clamp (7) and secure with one self-locking nut. Install breather tube cushioned clamp (5, fig. 3-51) and secure with one self-locking nut and flat washer.

3-176. Exhaust Pipes and Manifolds

a. Install exhaust manifold 4R, 5R, 6R using new gaskets and secure to cylinders with twelve self-locking nuts and flat washers (9, fig. 3-50). Install exhaust manifold elbow 4R, 5R, 6R using new gasket and secure to the exhaust manifold with four self-locking nuts, flat washers and bolts (7). Install exhaust manifold and exhaust elbow 4L, 5L, and 6L in the same manner.

b. Install crankcase breather tube hose on breather tube and secure loosely with two hose clamps (4). Install new gasket, restrictor (6), new gasket and tube tee (in that order) on rear fan drive housing, and secure with two bolts and lockwashers (5). Slide crankcase breather tube hose over tube tee and secure with hose clamps (4). Install breather tube tee hose and secure with hose clamp.

c. Install exhaust manifold 1L, 2L, 3L (3) using new gaskets and secure to cylinder with twelve self-locking nuts and flat washers. Install exhaust manifold elbow 1L, 2L, 3L (2) using new gasket and secure to exhaust manifold with four self-locking nuts, flat washers and bolts (1).

d. Install exhaust manifold 1R, 2R, 3R using new gaskets and secure to cylinder with twelve self-locking nuts and flat washers (3, fig. 3-49). Install exhaust manifold elbow 1R, 2R, 3R (2) using new gasket and secure to exhaust manifold with four self-locking nuts, flat washers and bolts(1).

3-177. Fuel Injector Clamps, Supports and Tubes

NOTE

Special precautions must be taken to ensure that all fuel injection pump tubes terminate at the proper cylinder (fig. 3-48). Incorrect hook up of the injector tubes to a wrong cylinder or injection pump connection would result in damage to the piston rings and cylinder walls and severe damage to the engine if operated under full load.

a. Individually install six fuel injector tubes from cylinder Nos. 1L through 6L to fuel injection pump rear hydraulic head. To assure adequate wrench clearance connect tubes to rear pump head in the following order 5, 3, 6, 2, 4 and 1. Start fittings on pump head and injector nozzle and holder assembly by hand until sleeve is seated. When sleeve is seated, an increase in torque will be evident. When this point is reached, torque tighten to 300 pound-inches. Tighten all fuel injector tube support nuts to 125 pound-inches.

NOTE

Overtightening will damage the support sleeve and cause fuel leaks. Overtightening the support nut can fracture the support sleeve and result in injector tube failure at this location.

b. Individually install six fuel injector tubes from cylinder No. 1R through 6R to front hydraulic head. To assure adequate wrench clearance connect tubes to front pump head in the following order 2, 4, 1, 6, 5 and 3. Secure tubes to pump head and injection nozzle and holder assemblies as outlined above.

NOTE

> The proper installation and positioning of the tube clamps is essential to insure tube life. Install all stationary clamps as shown in figure 3-48 for Model AVDS-1790-2C and AVDS-1790-2D engines, and figure 3-48.1 for Model AVDS-1790-2DR engine. The floating clamps must be installed as shown in figure 2-59 for Model AVDS-1790-2C and AVDS-1790-2D engines, and figure 2-59.1 for Model AVDS-1790-2DR engine, to insure maximum vibration dampening.

Figure 3-334. Deleted.

c. Install six fuel injector tube support brackets (8, fig. 3-48) as shown, on front and rear fan tower cover and secure with twelve self-locking nuts (7).

d. Install two tube clamps, one under and one over fuel injector tubes, and one plate on top of each clamp at each tube clamps support bracket and secure with twenty bolts and self-locking nuts (6).

e. Install two tube clamps, one under and one over fuel injector tubes, and one plate on top of each tube clamp support (4) and secure with twenty-four bolts and self-locking nuts (3).

f. Install two floating clamps, one under and one over fuel injector tubes, and one plate under and one over each clamp at location shown in figure 3-48 and secure with three bolts and self-locking nuts (1, fig. 3-48) and four bolts and self-locking nuts (2).

*f.*1. Install 12 plates and 24 tube clamps (one-tube) on right and left fuel injector tube clamp supports (4, fig. 3-48), and secure with 24 self-locking bolts (3). Install six fuel injector tube brackets and secure with 12 self-locking nuts (7, fig. 3-48.1). Install one plate and two tube clamps (one-tube) and secure with two self-locking nuts and machine bolts (6). Install one plate and two tube clamps (one-tube) and secure with one machine screw (5). Install two plates and four tube clamps (one-tube) and secure with four self-locking nuts and machine bolts (4). Install four fuel injector tube plates and eight tube clamps (three-tube) and secure with 16 self-locking nuts and bolts (2). Install 14 floating plates and tube clamps (two-tube) and secure with seven self-locking nuts and machine bolts (1).

g. Install a new connector gasket on special bolt, insert bolt through fuel tube elbow connector (fig. 3-47) and install a second new connector gasket on bolt. Install bolt with new gaskets and elbow connector in nozzle and holder assembly at cylinder No. 1R, 6R & 6L. Install eight bolts with new gaskets and tube tee connectors in the remaining nozzle and holder assemblies.(except No. 1L).

h. Install a new connector gasket on special bolt, insert bolt through fuel tube connector (fig. 3-46) and install a second new connector gasket on bolt. Install bolt with new gasket and connector in nozzle and holder assembly at cylinder No. 1L.

i. Position left nozzle fuel return hose and connect to fuel tube tee elbow connector at cylinder No. 6L (fig. 3-45). Position right nozzle fuel return hoses and connect to fuel tube elbow at cylinder No. 1R and 6R. Install ten fuel injector nozzle fuel return hoses to injector nozzle fuel tube tee connectors and fuel tube connector. Install elbow (5) and left fuel return tube assembly (4) and two loop clamps (6). Install elbow (2), right fuel return tube assembly (1) and two loop clamps (3).

3-178. Cylinder Head Plates, Oil Filler Tube, and Oil Level Indicator Tube

a. Install oil level indicator tube (10, fig. 3-44) using new gasket on oil pan and secure with three self-locking nuts (9).

NOTE

> Model AVDS-1790-2DR engine installation instructions for the cylinder head plates, oil filler tube, and oil level indicator tube are similar except that the oil level indicator tube is located between cylinder Nos. 2L and 3L.

b. Install ten intercylinder shroud plates (8) on cylinder heads and secure with twenty screws and lockwashers (7). Install damper end cylinder head shroud plate (6) and secure to cylinder head with two screws and lockwashers (5). Install flywheel end cylinder head shroud plate (4) on cylinder head and secure with two screws and lockwashers (3). Using a new gasket install lower oil filler tube assembly (2), hose and clamps on oil pan. Secure with three screws and three new seal washers (1). Install ten right intercylinder shroud plates, right damper end and flywheel end cylinder head shroud plates in the same manner as outlined above.

3-179. Front and Rear Shrouds

a. Install right rear shroud on engine and secure to flywheel end cylinder head shroud, No. 6R cylinder baffle and to lower right rear engine shroud with five machine screws (fig. 3-43). Install left rear shroud in the same manner.

*a.*1. Model AVDS-2D and AVDS-1790-2DR engines only. Install generator exhaust air outlet tube (3, fig. 3-288) and secure with two machine screws (6), flat washers (4) and lockwashers (5). Install right rear shroud on engine and secure to flywheel end cylinder head shroud, No. 6R cylinder baffle and to lower right rear engine shroud with five machine screws (fig. 3-43). Install left rear shroud in a similar manner. Install generator outlet preformed hose and secure with two hose clamps (fig. 2-73.1).

b. Install left front shroud (9, fig. 3-42) on engine and secure to damper end cylinder head shroud with machine screw (7). Install No. 1L cylinder baffle over cylinder (fig. 3-40) and secure to front shroud with two machine screws (8, fig. 3-42). Install side filler plate on left front shroud and secure to shroud with three assembled washer bolts (5) and to damper housing with three machine screws and lockwashers (4). Install top filler plate on damper housing and secure to damper housing with two machine screws and lockwashers (2) and to front shroud with assembled washer bolts (1).

c. Install fuel injection pump fuel cutoff lead through left front shroud and secure with four machine screws, lockwashers and nuts (7, fig. 3-41). Install flat washer on bulkhead elbow (5) and install elbow through left front shroud and secure with lockwasher and nut (6). Connect fuel injection pump fuel inlet hose (4) to bulkhead elbow. Install flat washer on fire extinguisher tube adapter (2) and install adapter through left front shroud and secure with lockwasher and nut (3). Connect fire extinguisher tube (1) to adapter.

c.1. Install bulkhead adapter (10, fig. 3-41.1) on shroud and secure with nut and lockwasher (11). Connect fuel return hose (9) to adapter. Install fuel injection pump fuel cutoff lead (8) through shroud and secure with four machine screws, lockwashers and nuts (7). Install bulkhead elbow (5) through shroud and secure with nut and lockwasher (6). Connect fuel injection pump fuel inlet hose (4) to bulkhead elbow. Install fire extinguisher bulkhead adapter (2) on shroud and secure with nut and lockwasher (3).Connect fire extinguisher tube (1) to bulkhead adapter.

d. Install right front shroud (5, fig. 3-39) on engine and secure to damper end cylinder head shroud with machine screws (3). Install No. 1R cylinder baffle over cylinder (fig. 3-40) and secure to front shroud with two machine screws (4, fig. 3-39). Secure front shroud to damper housing with machine screw and lockwasher (2) and to left front shroud with assembled washer bolt (1).

e. Install No. 1R cylinder barrel shroud on cylinder deflector and right front shroud and secure to shroud with two machine screws (fig. 3-38). Install No. 1L cylinder barrel shroud in the same manner except do not install the top machine screw at this time.

3-179.1 Power Takeoff Drive Housing

a. Install power takeoff drive housing on damper housing studs using new mounting gasket (fig. 2-148.4).

b. On engines using the late spur gearshaft with 7/8-14 inch threads, remove puller screw from alinement tool, part number 12275768, and insert alinement tool in power takeoff drive housing until firmly seated on the power takeoff spur gearshaft taper. With the alinement tool firmly seated on the spur gearshaft, install seven self-locking nuts and flat washers. Do not install self-locking nut and flat washer on stud located at the 9 o'clock position. Install puller screw and turn clockwise to remove alinement tool.

b.1. On engines using the early spur gearshaft with 3/4-16 inch threads, remove puller screw from alinement tool, part number 11684212, and insert alinement tool in power takeoff drive housing until firmly seated on the power takeoff spur gearshaft taper. With the alinement tool firmly seated on the spur gearshaft, install seven self-locking nuts and flat washers. Do not install self-locking nut and flat washer on stud located at the 9 o'clock position. Install puller screw and turn clockwise to remove alinement tool.

NOTE

Drive coupling taper and spur gearshaft taper areas must be wiped dry with dry-cleaning solvent (PD-680) to assure maximum friction.

c. On late engines (spur gearshaft with 7/8-14 threads), install power take-off drive coupling (1, fig. 2-148.2) and flat washer (4). Be certain power take-off spur gearshaft and coupling taper surfaces are dry and free from oil and grease. Coat nut threads only with engine oil OE/HDO-30, or equivalent, and install self-locking nut (3). Install holding bar and puller assembly, Part No. 12254282, on power take-off drive coupling and secure with two 7/16-20UNF x 1-1/2 inch capscrews (2). Hold holding bar and puller assembly to prevent crankshaft from turning, and torque tighten self-locking nut to 280 - 290 pound feet. Remove puller assembly.

c.1. On engines using the early spur gearshaft with 3/4-16 threads, install power takeoff drive coupling (1, fig. 2-148.2) and flat washer (4). Be certain spur gearshaft threads are dry and free from oil or grease. Coat nut threads with engine oil OE/HDO-30, or equivalent, and install nut (3). Install holding bar and puller assembly, Part No. 12254282, on power takeoff drive coupling and secure with two 7/16-20UNF x 1-1/2 inch capscrews (2). Hold holding bar and puller assembly to prevent crankshaft from turning. Note the prevailing nut torque (before nut bottoms against the flat washer), and add 190 pound-feet torque to complete the torque tightening procedure. Remove puller assembly.

3-180. Fuel/Water Separator, Automatic Drain System, and Solenoid

a. Install a new mounting bracket gasket and install fuel/water separator filter mounting bracket (fig. 3-37) on cylinder No. 1L and secure with three screws and flat washers.

b. Install fuel/water separator filter on mounting bracket and secure with two capscrews, lockwashers and flat washers (2, fig. 3-36), and one lower capscrew, lockwasher and plain washer (3). Connect fuel outlet hose (7) to bulkhead elbow and to filter elbow. Connect fuel inlet hose (6) to filter elbow.

c. Install assembled filter drain hose, bracket and drain cock (fig. 3-35) on damper housing stud and secure with self-locking nut. Install automatic water drain mounting bracket, control module, solenoid valve and fittings as an assembly on crankcase and secure with three screws and lockwashers (5, fig. 3-34). Connect assembled filter drain hose at solenoid valve nipple (4) and at filter elbow (3). Install cushioned clamp (1) on water level probe leads (2) and secure clamp to No. 1L cylinder barrel shroud with machine screw.

d. Install two water level probes (5, fig. 3-36) making sure that the probe from the upper connector of the control identified by red shrink tube, is installed in the upper filter opening. Install cushioned clamp on probe leads and install clamp lockwasher and capscrew (1) on fuel/water separator filter.

3-181. Throttle Linkage Cross Shaft and Brackets

Install a new camshaft end plate gasket and install throttle linkage cross shaft (12, fig. 3-33), camshaft end plate (10), with tachometer drive adapter (11) installed, as an assembly. Secure to No. 1R cylinder with one capscrew and lockwasher (9) and to damper housing with two assembled washer bolts (8). Position primary fuel filter and bracket (6) on camshaft end plate and secure to cylinder with two capscrews and lockwashers (5). Install manual fuel shutoff rod through front shroud, and secure to manual fuel shutoff lever (4) with flat washer and cotter pin (3). Check for full, free travel. Install adjustable rod through front shroud and secure to injection pump fuel lever (2) with self-locking nut and capscrew (1). Refer to paragraph 2-21*b*, for adjustment procedures.

3-182. Primary Fuel Filter

Install primary fuel filter outlet elbow (10, fig. 3-278) and constant bleed adapter (10, fig. 3-282) in filter. Install assembled filter (7, fig. 2-67) in filter bracket (8) and secure by tightening two self-locking nuts in filter bracket (6). See figure 2-67, 2-68 and 2-68.1 for position of filter in bracket.

3-183. Intake Manifold Assembly

a. Install six new intake manifold gaskets and install right intake manifold (4, fig. 3-32), and turbosupercharger air outlet elbow (6) as an assembly on the cylinders and secure with eighteen plain nuts and lockwashers (3, fig. 3-32). Secure intake manifold tube flange nuts.

b. Connect generator vent hose (1) to intake manifold elbow (2). (Model AVDS-1790-2C only). Install left intake manifold assembly in the same manner.

3-184. Cylinder Head Oil Drain Lines

a. Install new flat washers on six cylinder head oil tube bolts (1, fig. 3-31), install bolts through intermediate oil drain tubes and install new flat washers on bolts. Install right front drain tube (5) front (2) and rear (4) cylinder head oil drain tubes (3) as an assembly on cylinders and tighten six bolts (1) securing tubes to cylinders. Install locking wire securing bolts and tighten all hose clamps. Install left cylinder head oil drain tubes in the same manner.

b. Install turbosupercharger oil drain tube (fig. 3-30) and hoses on right rear cylinder head oil drain tube and loosely install hose clamps. Install tubes, hoses and clamps as an assembly on rear cylinder head oil drain manifold tube and tighten hose clamps. Install left rear cylinder head oil drain tube and turbosupercharger oil drain tube and hoses in the same manner.

c. Install new drain tube gasket and install left rear cylinder head oil drain tube on oil pan and secure with two capscrews and lockwashers (fig. 3-29). Install right rear (fig. 3-26) and right front (fig. 3-27) and left front (fig. 3-28) cylinder head oil drain tube in the same manner.

3-185. Manifold Heater Tubes, Solenoids and Filter

a. Install left (12 fig. 3-25) and right (11) rear center shrouds on accessory drive housing and secure with three machine screws and lockwashers (10). Install hose clamp (9) on crankcase breather tube tee hose. Install tube cross (8) and elbow through right rear center shroud and secure with flat washer and nut. Position solenoid bracket, solenoid valve (6), check valve (7), and fittings on left rear center shroud and secure with three assembled washer bolts (5). Install manifold fuel heater fuel return hose (4) through left rear center shroud and connect to check valve elbow. Install fuel return hose shroud grommet (3). Install two loop clamps on right manifold heater fuel return tube and connect tube to solenoid tee (1) and secure loop clamp with machine screw (2).

a.1. Deleted.

b. Connect manifold heater fuel return hose (5, fig. 3-24) to tube cross elbow. Connect fuel injector nozzle fuel return tubes (4) and fuel injector fuel return hose (3) to tube cross. Install turbosupercharger oil hose bulkhead adapter elbow (2) through left rear center shroud and secure with washer and nut. Connect turbosupercharger oil hose (1) to bulkhead adapter elbow.

b.1. On Model AVDS-1790-2C and AVDS-1790-2D engines, install backflow valve mounting bracket (26, fig. 3-278) on damper and filter housing and secure with two flat washers (27) and self-locking nuts (28). On Model AVDS-1790-2DR engines, install backflow valve mounting bracket (36) and secure with two flat washers (37) and self-locking nuts (38).

NOTE

If it is necessary to index new solenoid valves, loosen the acorn nut, index the valve, and torque tighten acorn nut to 50 pound-inches.

c. Install mounting bracket, solenoid valve, and manifold heater fuel filter (12, fig. 3-23) as an assembly on crankshaft damper and filter housing and secure with two self-locking nuts (11). Install fuel inlet tube (10). Install backflow valve (5) on mounting bracket and secure with two capscrews, lockwashers, and flat washers (9). Connect manifold heater fuel filter fuel inlet hose (7) at the filter (8). Connect backflow valve fuel inlet hose (6) at backflow valve (5) and at primary fuel filter. Install loop clamp (4) and secure to fuel pump adapter stud with self-locking nut (4). Connect right manifold fuel tube (3) and left manifold fuel tube (1) to solenoid outlet tee (2).

c.1 Connect oil inlet hose (13, fig. 3-23.1) to 45 degree elbow in power take-off drive housing and to 90 degree elbow on right side of crankcase. Install manifold heater filter, solenoid valve and mounting bracket (12) as an assembly and secure with two self-locking nuts (11). Install fuel backflow valve (10) and secure with two capscrews, lockwashers and flat washers (9). Connect fuel pump inlet hose (8) at the backflow valve. Install two cushioned clamps and secure with one self-locking nut (7). Install manifold heater fuel inlet tube (6). Connect backflow valve fuel inlet hose (5) at backflow valve and primary filter outlet. Connect left manifold heater fuel tube (1) to solenoid outlet tee (2). Connect right manifold heater fuel tube (3) to solenoid outlet tee (2). Install cushioned clamp (4) on right manifold heater fuel tube and secure with self-locking nut.

d. Install two grommets (4, fig. 3-22) in each oil cooler frame support (5) and install three supports on cylinder assemblies using six spacers and self-locking nuts. Install four cushioned hose clamps (3) on cylinder head oil drain tubes as shown in figure 3-22. Install four manifold heater fuel tube clamps (2) and secure to cushioned clamps with four capscrews and self-locking nuts (1). Install right manifold fuel tube clamps and oil cooler frame supports in the same manner.

3-185.1. Smoke Generating Solenoids and Fuel Tubes

a. On Models AVDS-1790-2C and AVDS-1790-2D, install solenoids and bracket (11, fig. 3-24.1) as an assembly. Secure to rear lifting eye with two capscrews (10) and lockwire. Connect tube nut of solenoid outlet tube (7) to outlet elbow of solenoids. Install elbow (8) and tee (9) on outlet tube (7). Install two new fuel tubes and connect tube nuts (4) to tee (9), install adapters (6) into exhaust manifolds and tighten tube nuts (5). Install two retaining straps and clamp pads (2) and secure with two capscrews and self-locking nuts (1). Attach tube nut of solenoid inlet fuel tube (3) to inlet elbow of solenoid and secure loop clamp to cam gear cover with nut (not shown).

b. On Model AVDS-1790-2DR, install the smoke generating solenoids, fuel tubes and associated hardware in a similar manner, except the two fuel tubes from the tee to the exhaust manifolds are secured to the rear shrouds with two loop clamps and assembled washer bolts.

3-186. Turbosupercharger Oil Inlet Hose and Transmission Shroud

a. Install grommet (fig. 3-21) on fuel return tube and position right transmission shroud on lower right engine shroud making sure grommet alines with slot in transmission shroud and secure with two machine screws.

b. Secure turbosupercharger oil inlet hose to tie rod and camshaft gear housing cover with assembled washer bolt and capscrew, and connect hose to bulkhead adapter elbow. Install left fuel return tube, transmission shroud and oil hose in the same manner.

NOTE

> Model AVDS-1790-2DR has two assembled washer bolts and cushioned clamps securing the turbosupercharger oil inlet hoses to the tie rod, and is not equipped with right and left transmission shrouds.

3-187. Oil Cooler, Support Beams, and Frame

a. Frame Support Brackets. Install six right frame support brackets (fig. 3-20) on cylinders and secure with twelve self-locking nuts. Install exhaust elbow retaining strap and secure with machine bolt and self locking nut. Install six left frame supports and retaining strap in the same manner.

a.1. Install one plate and two tube clamps (one-tube) and secure with one self-locking nut and machine bolt (3, fig. 3-48.1).

b. Left Oil Cooler Support Frame.

(1) Install left oil cooler support frame (7, fig. 3-19) on frame supports and secure rear shroud with assembled washer bolt (6). Install turbosupercharger support bracket (3) and secure to turbosupercharger tie rod with self-locking nut, bolt, grommet and two spacers (2). Secure turbosupercharger support bracket to oil cooler frame with capscrew and self-locking nut (1). Secure transmission upper shroud (5) to oil cooler support frame with three assembled washer bolts (4).

NOTE

> Model AVDS-1790-2DR has four assembled washer bolts (6, fig. 3-19) securing the rear shroud to the oil cooler support frame.

(2) Secure oil cooler support frame to supports with six capscrews and self-locking nuts. Connect manifold air heater fuel return tube to manifold heater elbow (5, fig. 3-18). Connect inlet tube to nozzle inlet elbow (4).

(3) Install ignition unit (3) with clamp on oil cooler support frame and secure with two capscrews and self-locking nuts (2). Connect manifold heater electrical lead (1) to manifold heater spark plug. Secure front shroud to oil cooler support frame with three assembled washer bolts (fig. 3-17).

c. Right Oil Cooler Support Frame.

(1) Install right oil cooler support frame (4, fig. 3-16) on frame supports. Install transmission upper shroud (5) and secure to rear shroud with two assembled washer bolts (3). Install turbosupercharger support bracket (2) and secure to turbosupercharger tie rod with self-locking nut, bolt, grommet and two spacers (1).

NOTE

> Model AVDS-1790-2DR has five assembled washer bolts (3, fig. 3-16) securing rear shroud to the oil cooler frame, and is not equipped with a transmission upper shroud (5).

(2) Secure turbosupercharger support bracket to oil cooler frame with capscrew and self-locking nut (7, fig. 3-15). Secure oil cooler support frame to supports with six capscrews and self-locking nuts (6). Connect manifold air heater fuel return tube (5) to manifold heater elbow. Connect inlet tube to nozzle inlet elbow (4). Install ignition unit with clamps (3) on oil cooler support frame and secure with two capscrews and self-locking nuts (2). Connect manifold heater electrical lead (1) to manifold heater spark plug.

(3) Install bulkhead union (fig. 3-14) and secure to front shroud with retainer nut. Secure front shroud to oil cooler support frame with assembled washer bolts. Connect fuel filter constant bleed hose to primary fuel filter adapter. Install cushioned clamp on bleed hose and secure to oil cooler frame and front shroud with assembled washer bolt.

(4) Connect fuel filter constant bleed hose (fig. 3-13) to bulkhead union and to fuel injector nozzle and holder connector.

d. Oil Coolers.

(1) Install transmission oil cooler screen bracket (9, fig. 3-12) on transmission oil cooler and secure bracket and cooler to support frame with two machine bolts (8). Secure transmission oil cooler with two machine bolts and flat washers (10).

(2) Install center oil cooler screen bracket (6) and damper end oil cooler screen bracket (5) and engine oil cooler screen (4) on engine oil cooler (7) as an assembly. Install brackets, screen and cooler as an assembly to the oil cooler support frame and secure with four machine bolts (3). Install transmission oil cooler screen (2) and secure with two assembled washer bolts (1) and one flat washer. Install engine and transmission oil coolers on left bank in the same manner.

(3) Connect left and right oil cooler oil inlet hose (12, fig. 3-11) at damper housing (11) and at cooler (10). Install cushioned hose clamp on left and right oil cooler oil inlet hose as shown in figure 3-11. Install left and right manifold heater fuel tube clamp and secure to cushioned clamps with screw and self-locking nut (8). Connect left and right oil cooler oil outlet hoses (9) at damper housing (11) and at oil coolers (10).

(4) Connect fuel filter constant bleed hose (6) at bulkhead union (7). Install oil cooler vent lines (2), tee, and four cushioned clamps as an assembly and connect vent lines at damper housing vent adapter, (5) left oil cooler vent adapter (3), and right oil cooler vent tee (4). Secure cushioned clamp to shroud with assembled washer bolt (1).

e. Installation Guide and Time Totalizing Meter.

(1) Install left installation guide (fig. 3-335) on damper housing and secure with two self-locking nuts and flat washers at bottom. Install hose clamp on fuel inlet hose and secure clamp and guide to damper housing with two self-locking nuts.

(2) Remove two lower self-locking nuts (1, fig. 3-10) securing lifting eye to damper housing. Install time totalizing meter (4) and right installation guide (3) and secure guide and meter to damper housing with four self-locking nuts (1) and two self-locking nuts and washers (2).

e.1. Time Totalizing Meter. **Remove two self-locking nuts (1, fig. 3-10) from the two lower studs securing the right lifting eye to the damper housing. Install time totalizing meter (6, fig. 3-10.1) and spacer (5) and secure with three self-locking nuts (3) at the two top studs, and the lower left stud. Connect electrical lead (1) to time totalizing meter. Install ground lead (4) on lower right stud and secure with self-locking nut (3). Install two cushioned clamps on electrical lead and secure to engine with two capscrews and lockwashers (2).**

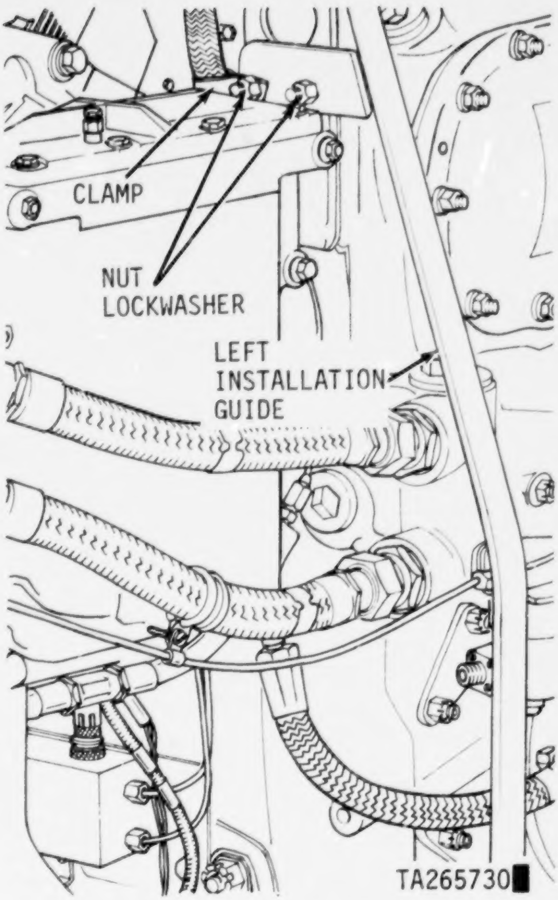


Figure 3-335. Installing left installation guide, model AVDS-1790-2C and AVDS-1790-2D engines.

e.2 Install oil sampling drain cock (fig. 3-3) on Model AVDS-1790-2DR.

3-188. Cooling Fan Shrouds, Upper Covers, Cooling Fans and Vanes

CAUTION

Do not run engine above idle and not longer than ten minutes without cooling fans.

NOTE

The fuel injection pump, fuel tubes, and fuel tube connections must be checked for fuel leaks with the engine running before the cooling fans are installed.

a. Install a fan rotor hub sleeve spacer part number 10882651 (fig. 3-336) on each fan drive vertical drive shaft to prevent oil seepage at fan drive oil seals while operating engines. Secure the sleeve spacer to each drive shaft with the same nut used to secure the cooling fan. Start engine and check for fuel leaks. If leaks are evident, loosen the tube fittings and retighten.

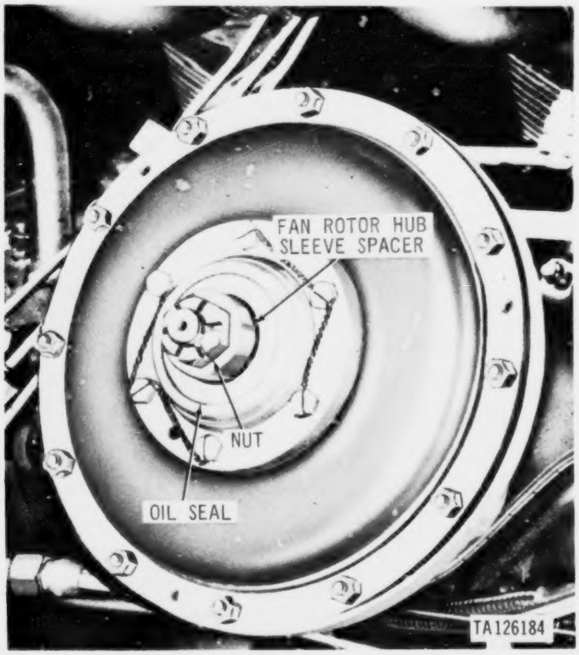


Figure 3-336. Front fan drive housing fan rotor hub sleeve spacer installed for leakage test.

NOTE

NEVER OVERTIGHTEN when attempting to remedy a fuel leak. Overtightening will deform the sleeve and eventually lead to tube failure. It is permissible to loosen the nut, or fitting, and retighten. This procedure will, in many cases, seal the fuel leak. The loosening and tightening operation tends to reseat the sleeve, thus providing an effective seal. Replace tubes rather than overtighten to stop leaks.

b. Install cooling fan shroud and fan housing as an assembly on top frame retaining brackets. Secure left and right center shroud, left and right rear shroud, and two fuel return line clamps to cooling fan shroud with three assembled washer bolts (2, fig. 3-9). Install four assembled washer bolts, flat washers and hexagon nuts (1), securing rear shroud and cylinder head fuel return tube clamps to rear shroud.

b.1. Install cooling fan shroud and fan housing as an assembly on top frame retaining brackets. Secure left and right center shroud, left and right rear shroud, and two fuel return line clamps to cooling fan shroud with three assembled washer bolts (2, fig. 3-9.1) and self-locking nuts (not shown). Install four assembled washer bolts and self-locking nuts (1), securing rear shroud and cylinder head fuel return tube clamps (not shown) to inside of rear shroud.

b.2. Secure cooling fan shroud and oil cooler vent line clamps to left and right front shrouds with five assembled washer bolts (fig. 3-8).

c. Install rear cooling fan and hub assembly (fig. 3-7) and vertical drive shaft and secure with flat washer and slotted nut. Torque tighten slotted nut to 600 pound-inches and secure with new cotter pin. Install front cooling fan and hub assembly in the same manner.

d. Install right front and rear upper covers (15 and 14, fig. 3-6) on oil cooler frame and secure with 12 assembled washer bolts (13). Install two preformed packings on oil indicator tube neck and position left rear and left front upper covers (12 and 11, fig. 3-6) on oil cooler support frame and secure with twelve assembled washer bolts (10). Open oil indicator tube cap (9), and install oil gage indicator rod. Secure cooling fan shroud to left and right top frame brackets with twelve self-locking nuts and flat washers(8) and two assembled washer bolts (right side only).

d.1. On engine Model AVDS-1790-2DR, install right front upper cover (16, fig. 3-6.1) and right rear upper cover (18) on oil cooler frame and secure with twenty two assembled washer bolts (15 and 17). Install cover adapter (14) and secure with five assembled washer bolts (13). Install left rear upper cover (12) and secure with eight assembled washer bolts (11). Install two new preformed packings on oil indicator tube neck and install left front upper cover assembly (10), (with oil level indicator tube cap attached) and secure with nine assembled washer bolts (9). Install retaining strap (8) and secure with two assembled washer bolts (7). Install four assembled washer bolts (6) and twelve self-locking nuts and flat washers (5) to secure cooling fan shroud to top frame. Open oil indicator tube cap (4) and install oil gage indicator rod. Close oil indicator tube cap.

e. With cooling fan shroud and fan housing installed, check clearance between end of each cooling fan blade and rim of cooling fan housing with feeler gage (fig. 3-337). Clearance must be 0.062 inch minimum. When clearance is not within limits loosen screws and shift housing as necessary until clearance is obtained.

f. Install cooling fan vane (3, fig. 3-6) on rear fan housing (7) and secure with two capscrews and lockwashers (6) and two bolts and lockwashers (5). Install cooling fan vane (3) on front fan housing (4) and secure with two capscrews and lockwashers (2) and bolts and lockwashers (1).

g. Deleted.

h. Deleted.

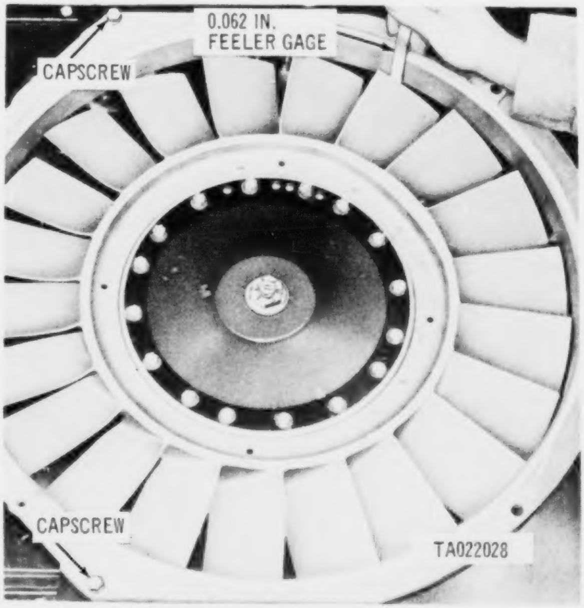


Figure 3-337. Checking cooling fan blade clearance.

3-188.1. Oil Sampling System

Install oil sampling system assembly to right bank oil coolers as shown in figure 3-5.5. Attach coupling nut of transmission oil inlet line (3) to adapter (4). Attach coupling nut of engine oil inlet line (2) to tee (1). Secure bracket (7) to right rear upper cover with two assembled washer bolts (6). Secure oil inlet lines to right upper covers with four assembled washer bolts and loop clamps (5).

3-188.2. Smoke Generating System

a. Install smoke generating fuel tube and secure to left upper covers with three assembled washer bolts and loop clamps (fig. 3-5.3). On Model AVDS-1790-2DR. install four assembled washer bolts and loop clamps. Secure bulkhead elbow to shroud with flat washer, lockwasher and retaining nut (fig. 3-5.4) and connect solenoid valve inlet tube nut to outlet of bulkhead elbows.

b. Install fuel shut-off valve to mounting bracket and secure with two capscrews and self-locking nuts (4, fig. 3-5.2). Attach valve and bracket assembly to front of shroud plate with two assembled washer bolts (3).

c. Connect fuel outlet tube nut (2) to fuel shut-off valve. Attach fuel hose (1) to shut-off valve and to fuel/water separator tee (fig. 3-5.1).

3-189. Engine Accessories and Wiring Harness

a. Install multiple leg sling part number 12257229 (fig. 3-1) on suitable chain hoist. Install hooks of sling in engine lifting eyes and take up slack. Remove four bolts and flat washers securing engine to overhaul stand brackets. Lift engine and remove overhaul stand. Lower engine on suitable blocks or movable dolly maintaining lifting sling hook-up as a precaution against engine tipping during remaining assembly operations.

a.1. Lift Model AVDS-1790-2DR using engine lifting sling, part number 11671664, in a manner similar to *a* above. However, the front of the engine is lifted at the crankshaft damper and filter housing lifting eyes.

b. Install fuel pump as outlined in paragraph 2-17*b* or 2-17.1*b*.

c. Install starter and cradle as outlined in paragraph 2-18*b*.

NOTE

Model AVDS-1790-2DR starter installation instructions are similar to those in paragraph 2-18*b* except that this engine is not equipped with a wiring harness.

d. Install generator oil drain nipple (fig. 3-4). Install check valve with directional arrow pointing toward cylinder head oil drain tube. Install elbow and drain hose in right rear cylinder head oil drain tube (Model AVDS-1790-2C only). Install generator and cradle as outlined in paragraph 2-19*a*(2) or 2-19*b*(2).

CAUTION

It is of utmost importance that the generator support, cradle, and U-bolt be installed in such a manner that will not disturb generator mounting alinement and still furnish adequate support to minimize vibration. Misalinement of 0.010 in. in any direction is sufficient to cause a leak (Pressure loss) between the generator mounting flange and the generator mounting adapter.

NOTE

Model AVDS-1790-2DR generator installation instructions are similar to those described above except that this engine is not equipped with an engine wiring harness.

e. Install turbosuperchargers, lower shroud plates, upper oil filler tube and crankcase rear breather tube as outlined in paragraph 2-20*b*.

f. Install wiring harness as outlined in paragraph 2-49*a*(2).

NOTE

Model AVDS-1790-2DR is not equipped with an engine wiring harness.

Pressure test induction system by sealing the turbosupercharger air inlet and outlet with suitable covers and pressurizing the system to 15 psi. The right bank induction system may be pressurized through the generator vent hose (10, fig. 2-15). The left bank may be pressurized by removing a pipe plug (10, fig. 3-270) from the intake manifold elbow and pressurizing through the opening. Pressurize to 15 psi, shut off air and note results. A gradual loss of pressure is permissable, but a sudden loss of pressure indicates a missing or loose pipe plug, missing gasket or loose connection. Repair leaks and retest.

3-189.1. Clean Air Package

For assembly procedures for the clean air package on the Model AVDS-1790-2CA and Model AVDS-1790-2DA, refer to Chapter 4.

NOTE

After the engine has been completely assembled it should be tested and the necessary adjustments made as directed in section XXIX.

Section XXIX. ENGINE TEST AND ADJUSTMENTS

3-190. Engine Specifications

a. Speed Range. The engine must operate satisfactorily under all loads through a speed range of 1000 to 2400 rpm and must idle satisfactorily at 675 to 725 rpm.

b. Gross Horsepower (Without Accessories). Under full throttle setting, engine will develop 735 to 780 gross horsepower at 2400 rpm, using fuel conforming to Specification VV-F-800 (DF-2).

c. Gross Torque (Without Accessories). Under full throttle setting, engine will develop the following gross torque using fuel conforming to Specification VV-F-800 (DF-2).

(1) 1770 to 1842 lb/ft @ 1800 rpm.

(2) 1609 to 1707 lb/ft @ 2400 rpm.

d. Oil Consumption. Engine shall not consume more than 0.0075 pounds per brake horsepower hour (lbs/bhp/hr) of lubricating oil when operating under full load and using engine oil conforming to Military Specification MIL-L-45199 Grade 2 (OE 30).

e. Fuel Consumption (Without Accessories). When operating at full throttle under full load, on a dynamometer, at a speed of 2400 rpm, engine shall consume not more than 0.420 pounds per brake horsepower hour (lbs/bhp/hr) fuel conforming to Specification VV-F-800 (DF-2). When operating at full throttle under full load, on a dynamometer at 1800 rpm, the engine shall not consume more than 0.400 lbs/bhp/hr of fuel conforming to VV-F-800 (DF-2).

f. Exhaust Gas Temperature. Exhaust gas temperatures, measured at individual cylinder ports, shall not exceed 1250° F. Temperature variation between cylinders shall not exceed 150° F. under full load conditions.

g. Blow-by Pressure. With engine under full throttle and full load, blow-by shall not exceed 18 cfm with new cylinders, and 21 cfm with used cylinders.

h. Lubricating Oil Temperature. Temperature of oil in the engine oil pan sump shall not exceed 250° F. Temperature of oil entering the engine through the oil pump shall be maintained between 140° F. and 250° F.

i. Oil Pressure. Engine oil pressure shall not be more than 70 psi or less than 40 psi when engine is operating at 2400 rpm, and shall not be less than 15 psi when engine is idling at 700 rpm, measured at and/or adjacent to the oil pressure sending unit, with oil temperature of 140° to 250° F., using engine oil specified in *d* above.

j. Temperatures. The preferred induction air inlet temperature is 85° F. plus or minus 10° F.

k. Fuel Pressure. The fuel pressure at the injection pump inlet shall be 40-60 psi at engine speeds of 1800 to 2400 rpm.

l. Manifold Pressure. Intake manifold pressure rise above atmospheric after the turbosupercharger with boost to 0 inches Hg. atmospheric pressure, shall not exceed 35 inches Hg.; without boost 28 to 32 inches Hg. Variation between left and right banks shall not exceed 4 inches Hg.

m. Exhaust Smoke Density Test. The maximum exhaust smoke density at full power position, with breather tube disconnected, when measured within one foot of the exhaust outlet, shall not exceed the following conditions when using fuel in accordance with grade DF-2 of Specification VV-F-800.

Engine RPM	*No.*	*Visual*	*Robert bosch meter No.*
1800	3	Light Gray	3.5
2000	3	Light Gray	3.2
2200	2	Haze	2.6
2400	1	Clear	2.4

NOTE

The meter readings shall have precedence over the visual reading.

3-191. Engine Run-In

a. General. This paragraph describes run-in schedules for overhauled or rebuilt engines prior to being placed in service. Engine run-in is performed after rebuild to assist in breaking in new parts, to detect faulty assembly, to check for oil leaks, and to determine whether an engine will operate satisfactorily when installed in vehicle.

b. Preparation for Run-in.

(1) Couple engine to suitable load. The load may be a water brake or electric dynamometer.

(2) Lubricate engine by forcing engine oil under pressure into lubrication system. This will insure adequate lubrication to engine parts until oil is circulated under pressure from engine oil pump. When prelubrication equipment is not available, fill all external lines and oil coolers with proper grade oil. Fill crankcase with proper grade oil.

(3) Connect external source of fuel supply to engine. Connect same type air cleaners that are used with engine when installed in vehicle. Air intake should be located so that only cool, fresh air will be inducted into engine. A means must be provided for conducting exhaust gases and cooling air from engine to avoid recirculation through engine cooling fans.

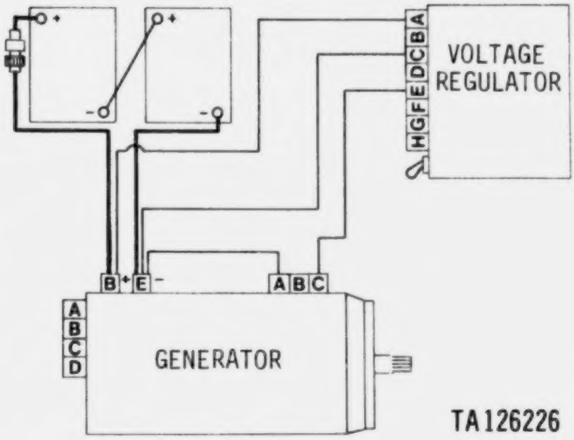

VOLTAGE REGULATOR
A
B
C
D
E
F
G
H
+
+
-
-
GENERATOR
B
+
E
-
A
B
C
A
B
C
D
TA126226

Figure 3-337.1. Wiring schematic for AVDS-1790-2C generator during engine test.

(3.1) Provide a suitable external source of 24 volt direct current electrical power for starting the engine. The engine is equipped with a low voltage protective module so starter will not operate below 12 volts.

CAUTION

On AVDS-1790-2C engines it will be necessary to load the generator to 50 amperes to prevent damage to the generator drive gear-slip clutch. Connect the generator to the voltage regulator and batteries as shown in figure 3-337.1.

(4) Remove engine cooling fan vanes and cooling fans (para 3-6). Install two fan rotor hub sleeve spacers part number 10882651 (fig. 3-336).

(5) Check operation of manual fuel shutoff (fig. 3-338). Refer to figures 3-338.1 and 3-339 for engine connection points.

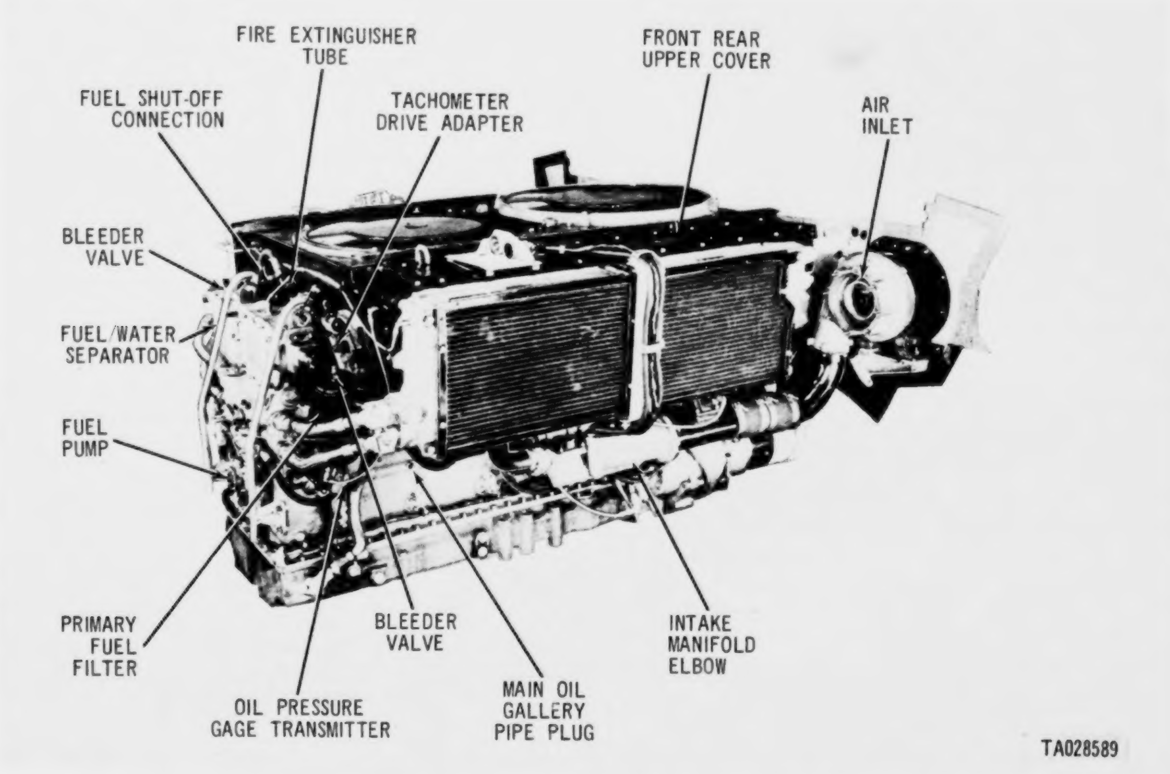

FIRE EXTINGUISHER TUBE
FRONT REAR UPPER COVER
FUEL SHUT-OFF CONNECTION
TACHOMETER DRIVE ADAPTER
AIR INLET
BLEEDER VALVE
FUEL/WATER SEPARATOR
FUEL PUMP
PRIMARY FUEL FILTER
BLEEDER VALVE
INTAKE MANIFOLD ELBOW
OIL PRESSURE GAGE TRANSMITTER
MAIN OIL GALLERY PIPE PLUG
TA028589

Figure 3-338. Engine connection points–right front view, model AVDS-1790-2C and AVDS-1790-2D engines.

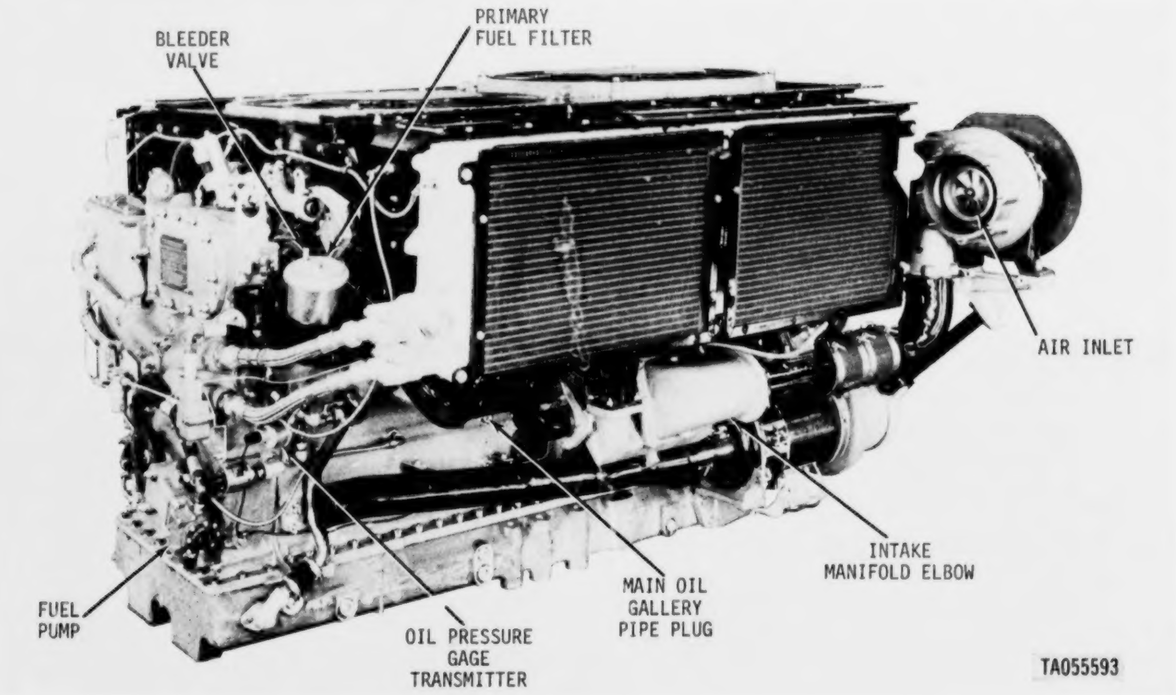

BLEEDER VALVE
PRIMARY FUEL FILTER
AIR INLET
INTAKE MANIFOLD ELBOW
MAIN OIL GALLERY PIPE PLUG
FUEL PUMP
OIL PRESSURE GAGE TRANSMITTER
TA055593

Figure 3-338.1. Engine connection points–right front view, model AVDS-1790-2DR engine.

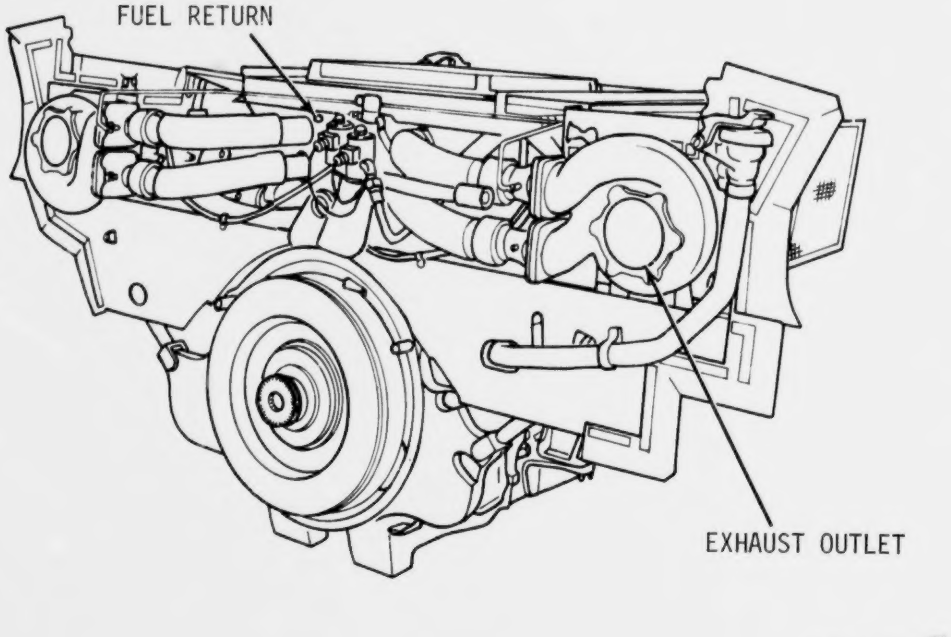

FUEL RETURN
EXHAUST OUTLET
TA265731

Figure 3-339. Engine connection points–left rear view, model AVDS-1790-2C and AVDS-1790-2D engines.

(6) Check operation of manual fuel shutoff (fig. 3-339.1).

(7) Open bleeder valves (fig. 3-338.1) on both the primary fuel filter and the fuel/water separator filter. Turn on source supply fuel pump and bleed air from filters. Close bleeder valves when fuel flows from filter.

WARNING

Do not attempt to start engine unless the fuel shutoff solenoid is connected and ascertained to be operative.

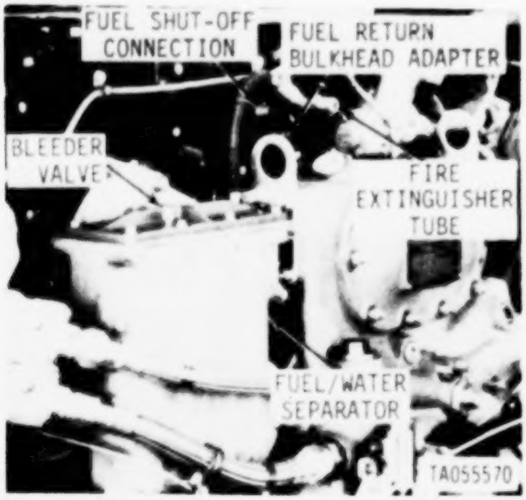


Figure 3-339.1. Engine connection points–left front view, model AVDS-1790-2DR engine.

(8) Crank engine several revolutions with the fuel shutoff in the "OFF" position to make certain the engine is not hydrostatically locked and is otherwise free.

(9) Wash all fuel and oil from the engine.

c. Run-In.

(1) Start the engine with the throttle lever in idle position. Oil pressure should be a minimum of 15 psi within 20 seconds.

CAUTION

Do not operate the starter motor continuously for more than 30 seconds. Allow a two-minute cool-off period before re-energizing the starter.

(2) Run the engine at 700-750 RPM and check for fuel and oil leaks. Should leakage be detected, immediately shut off engine and repair. After five minutes of operation, check oil level and add sufficient oil to bring oil level to "FULL" mark on oil level gage. Oil level must be determined with engine idling.

CAUTION

Do not run engine longer than 10 minutes at 700-750 RPM without cooling fans.

(3) *Stop engine.* Remove two fan rotor hub sleeve spacers. Install engine cooling fans (para 3-189). Check cooling fan blade clearance (para 3-189). Install cooling fan vanes (para 3-189).

d. Final Test

(1) Start engine and check all items vital to safe engine operation, such as fuel lines, oil lines, oil pressure, throttle control, mounting bolts, couplings, thermocouple harness, etc. Make sure test cell, observation window, and control room are neat and clean. During the warm-up period, fill out heading of log sheet completely.

(2) On Models AVDS-1790-2C and AVDS-1790-2D, adjust for idle at 700-750 RPM by turning idle adjusting screw (D, fig. 2-57). Loosen locknut on idle adjusting screw and turn screw clockwise to increase idle speed, and counterclockwise to decrease speed. Tighten locknut. Allow engine to run for 15-20 minutes at 700-1000 RPM. Check for unusual noises in the engine and generator which might indicate malfunction or lack of lubrication.

(3) On Model AVDS-1790-2DR, adjust for idle at 700-750 RPM by turning idle adjusting screw, (D, fig. 2-57.1). Loosen locknut on idle speed adjusting screw (fig. 2-148.7) and turn screw clockwise to increase idle speed, and counterclockwise to decrease speed. Tighten locknut. Allow engine to run 15-20 minutes at 700-1000 RPM. Check for unusual noises in the engine and generator which might indicate malfunction or lack of lubrication. Loosen locknut on solenoid control speed screw (fig. 2-148.7). Increase speed above 2000 RPM and activate solenoid. The solenoid should control engine speed at 1800 ± 25 RPM, no load. If adjustment is necessary, turn the screw clockwise to decrease speed, and counterclockwise to increase speed. Tighten locknut.

(4) Perform test in accordance with the schedule in table 3-28.

(5) Set manifold pressure manometers to current wet barometer reading and entrance air inclinometer to dry barometer reading, as applicable.

(6) Check cylinders for firing. Enter time and RPM at start of each period. Complete readings as soon as engine temperatures have stabilized. Plot oil consumption every ten minutes at 2400 RPM–full load, during run No. 8 (table 3-28). Determine that the governor is not limiting the fuel flow.

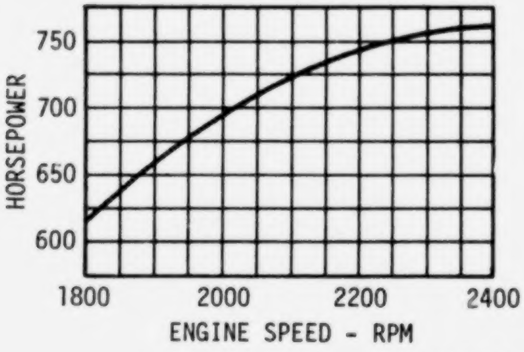
(7) Exhaust gas temperatures, measured at individual ports, must not exceed 1250 degrees F. Temperature variation between cylinders must not exceed 150 degrees F.

(8) At completion of test schedule, check acceleration, idle speed, and idle oil pressure. Acceleration should be checked with a moderate steady throttle movement.

(9) If power is outside limits, check for cause and make correction. Gross corrected hp. shall be maintained between 735 and 780 at 2400 rpm, full rack and full load (fig. 3-40).

(10) Governor shall be adjusted to limit the engine no load speed as follows:

Low Idle	675-725
High Idle	2600-2640



TA055571

Figure 3-340. Mean performance curve.

Table 3-28. Test Schedule

Run No.	Time (min.)	Rpm	Scale units	Bhp. obs.	Torque lb-ft.
1.	10	700	Warm up		
2.	15	1000	16.0	16.0	85
3.	15	1400	83.5	116.9	440
4.	20	1800	159.5	287.1	837
5.	20	2200	195.0	429.0	1024
6.	20	2400	208.0	499.2	1092
7.	30	2400	229.0	549.6	1202
8.	30	2400	*FR-FL	*FR-FL	*FR-FL
9.	Check for low idle at 675-725 rpm – Adjust if necessary.				
10.	Inspect for oil and fuel leaks.				
11.	Check governor high idle speed. This shall be 2600-2640 (no load - water off). If adjustment is required, recheck horsepower at 2400 full load.				
12.	AVDS-1790-2DR Engines: Adjust auxiliary drive governor speed to 1750-1800 rpm, no load - water off.				
13.	5	2400	*FR-FL		
14.	5	2200	*FR-FL		
15.	5	2000	*FR-FL		
16.	5	1800	*FR-FL		

*Full rack and full load.

(11) Adjust for smooth low idle, if necessary. Governor under-run below low idle setting during deceleration is permissible providing the governor return to low idle response is positive with steady operation at the low idle setting.

(12) During test with oil temperature of 140 degrees to 250 degrees F. at the oil cooler outlet, the oil pressure shall not be more than 70 nor less than 40 psi measured at and/or adjacent to the pressure sending unit, when the engine is operating at 2400 rpm, using Grade 30 oil, and shall not be less than 15 psi when engine is idling.

(13) After completing run No. 16, check flame heater system for operation and fuel leaks.

(14) If the engine will be used in 30 days, remove from test and cap or plug all openings. If the engine will be stored longer than 30 days, preserve as directed in paragraph 3-192.

NOTE

Any new cylinders that were installed while repairing the engine should have the intake and exhaust tappet settings rechecked at this time, refer to paragraph 2-52.

NOTE

If a dynamometer is not available, the engine may be installed in a vehicle and the vehicle driven at equally increasing speed increments from 0 to maximum speed in 15-minute intervals over the first three hours of operation. The engine may then be considered run-in.

3-192. Engine Preservation

a. Equip an auxiliary fuel container, with a fuel line, and fill with a sufficient amount of preservative oil, conforming to Specification VV-L-800, to operate the engine as prescribed below. Arrange the container to provide adequate pressure to assure proper supply of the preservative oil to the fuel system. Disconnect the fuel line at the most convenient point nearest to the engine fuel pump and connect the line from the auxiliary fuel container to the fuel-to-engine line at the point of disconnect. Disconnect the engine fuel return line and connect a transparent plastic tube to the fuel return connection. Insert other end of plastic tube into a container to collect the return diesel fuel. The fuel valve on the auxiliary fuel container shall be turned to the "ON" position; the engine started and operated at 750-1000 RPM until observed fuel return is purged of diesel fuel and the system filled with preservative oil.

b. Remove engine from test stand and cap or plug all openings.

CHAPTER 4
CLEAN AIR SYSTEM

Section I. DESCRIPTION.

4-1. General.

The Clean Air System is composed of the Dust Detector System and the Dust Ejector System.

4-2. Dust Detector System.

a. The dust detector system (figs. 4-1 through 4-3) provides dust detection capabilities when dust is being ingested into the engine air induction system.

b. The system is composed of two turbosuperchargers (figs. 4-2 and 4-3) equipped with special compressor housings. The compressor housings include the orifices and filters necessary for dust detection. The compressor housings are connected to pressure switches (figs. 4-2 and 4-3) with high and low pressure hoses, which detect pressure differential. The pressure switches are energized by the engine starter (positive) electrical harness (fig. 4-1).

c. The dust detector system uses engine air induction manifold pressure to circulate air through the filter strips mounted in the compressor housings. When the filter strip(s) becomes restricted from dust ingestion, the pressure switch senses a change in differential pressure. The pressure differential trips the pressure switch plunger(s) (fig. 4-2) and activates the power plant warning lamp and special dust warning lamp in the driver's compartment. Both warning lamps will light if either or both pressure switches detect a restriction in the filter strip(s).

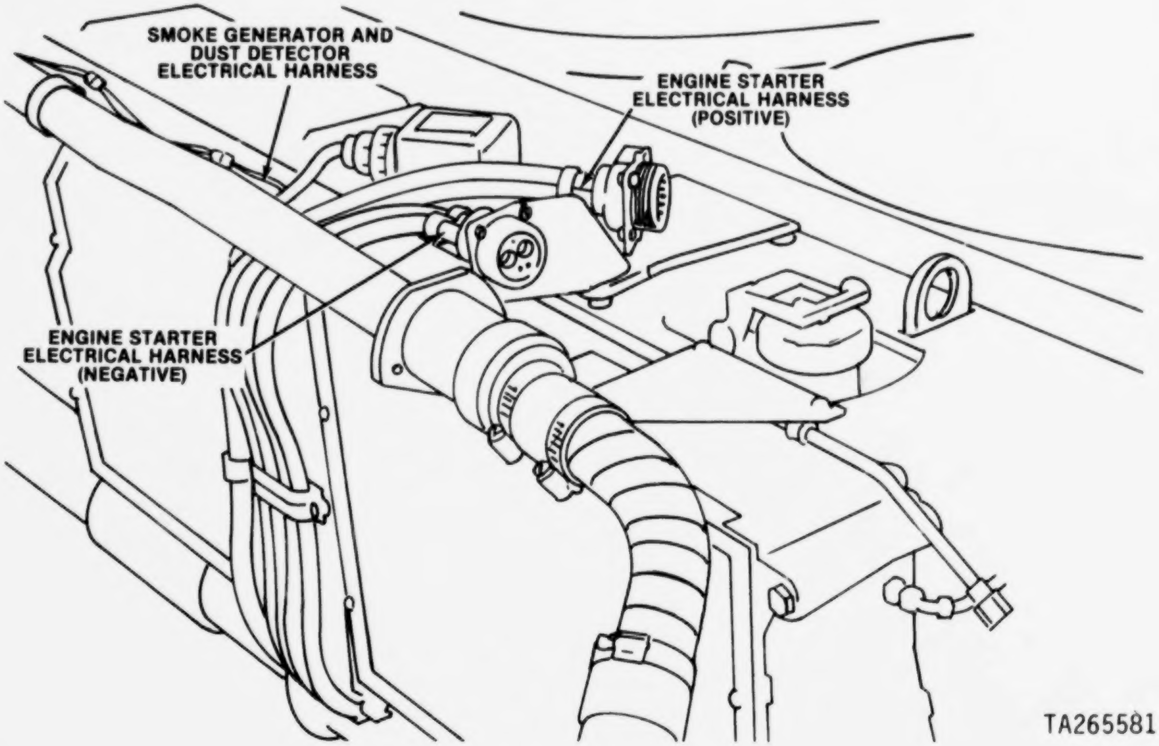

SMOKE GENERATOR AND DUST DETECTOR ELECTRICAL HARNESS
ENGINE STARTER ELECTRICAL HARNESS (POSITIVE)
ENGINE STARTER ELECTRICAL HARNESS (NEGATIVE)
TA265581

Figure 4-1. — Starter, Smoke Generator and Dust Detector System Electrical Harness

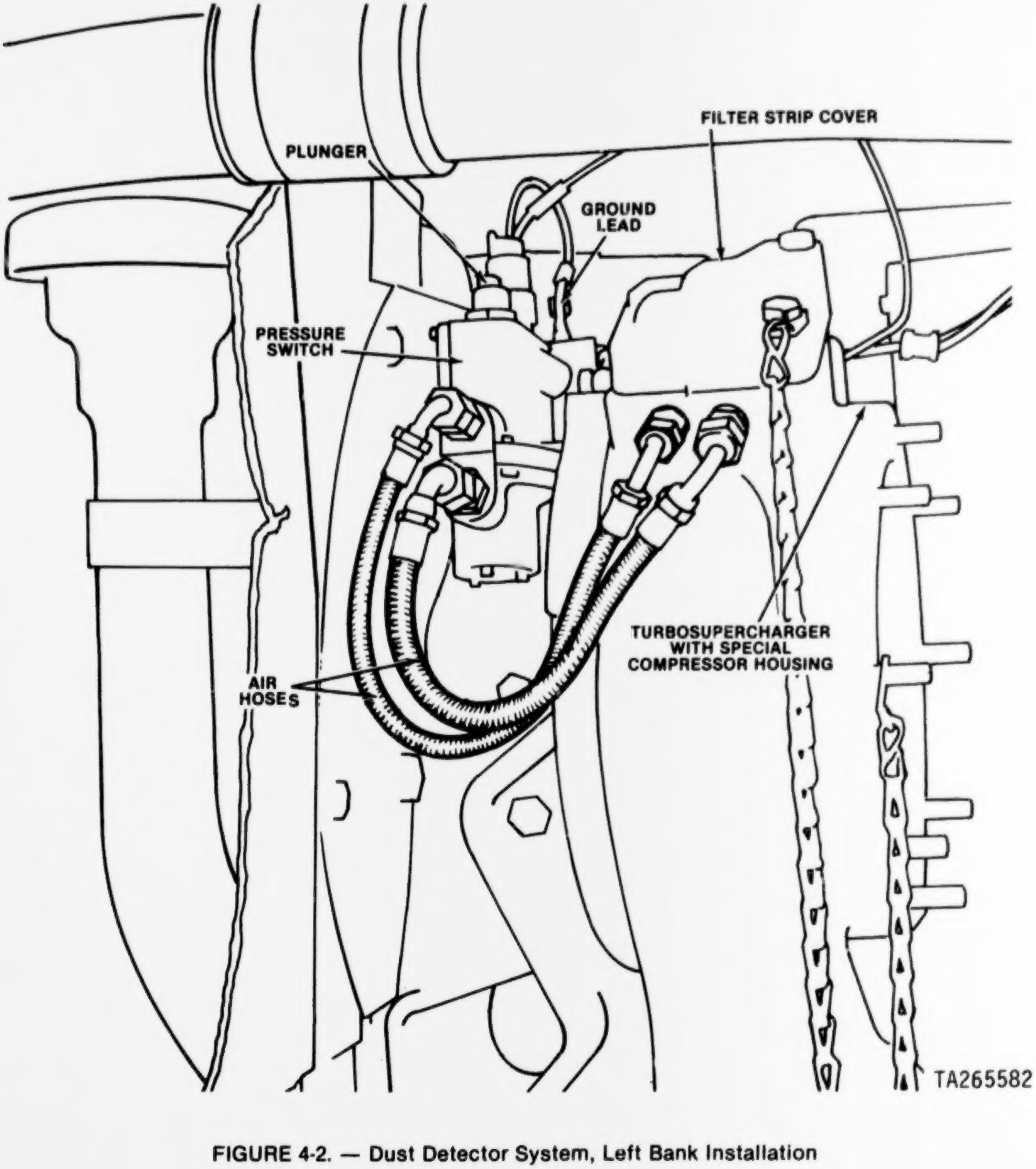

FILTER STRIP COVER
PLUNGER
GROUND LEAD
PRESSURE SWITCH
TURBOSUPERCHARGER WITH SPECIAL COMPRESSOR HOUSING
AIR HOSES
TA265582

FIGURE 4-2. — Dust Detector System, Left Bank Installation

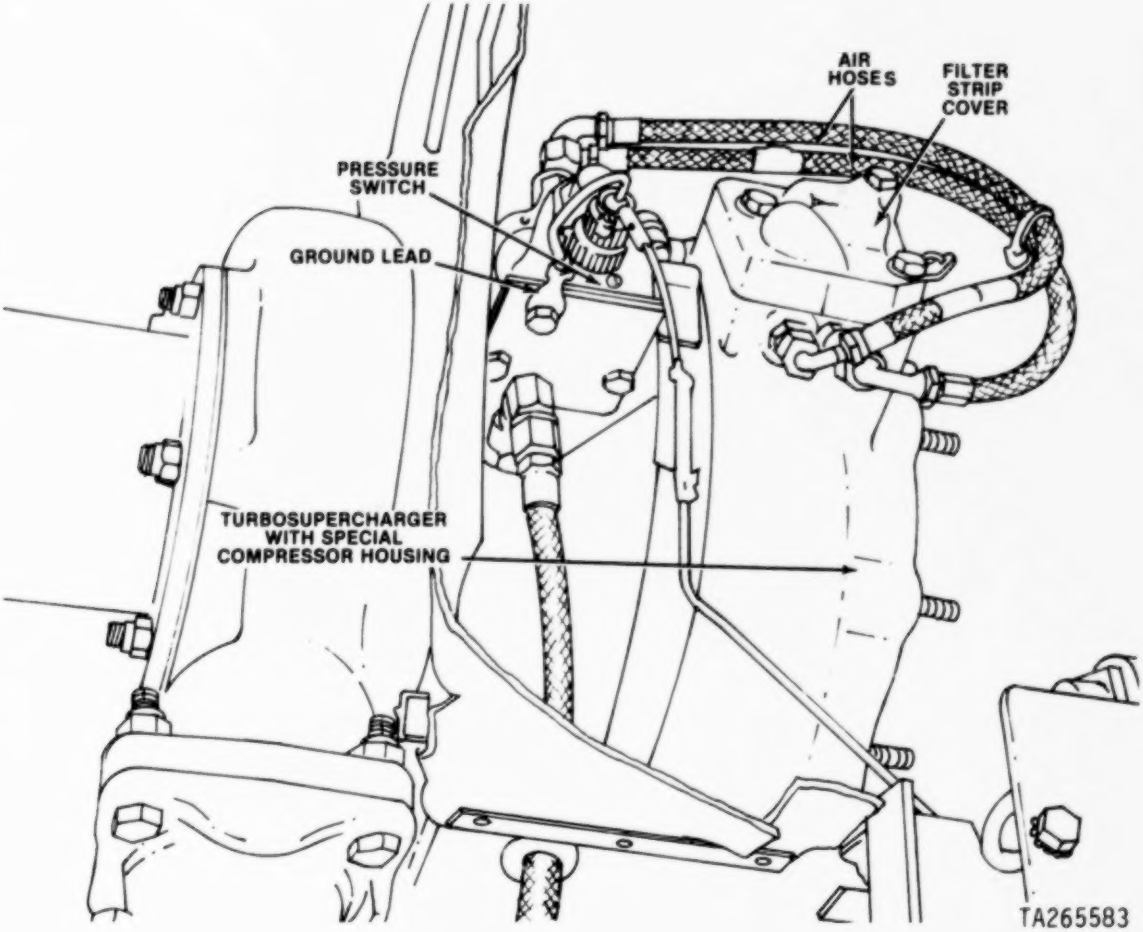

AIR HOSES
FILTER STRIP COVER
PRESSURE SWITCH
GROUND LEAD
TURBOSUPERCHARGER WITH SPECIAL COMPRESSOR HOUSING
TA265583

Figure 4-3. Dust Detector System, Right Bank Installation

4-3. Dust Ejector System.

a. The dust ejector system (fig. 4-4) provides dust ejection capabilities when dust is being ingested into the vehicle air cleaner system.

b. The system is composed of scavenge inlet tubes (fig. 4-4), exhaust pipe cap assemblies, and exhaust pipes with integral dust ejector nozzles. These components are mounted above and parallel to the oil coolers on each side of the engine. This system also includes special engine and transmission breather tubes, and a new oil filler tube.

c. The dust ejector system uses engine exhaust gas velocity to produce a scavenging action through the system. Engine exhaust flowing through the ejector nozzles produces a pressure differential which creates the air flow for the scavenging action in the vehicle pre-cleaner. The dust-laden scavenge air flows through the ejector nozzles, mixes with the exhaust gases, and exits through the exhaust pipes. The exhaust pipe cap assemblies prevent the back-flow of exhaust gases and/or water entry during fording operations.

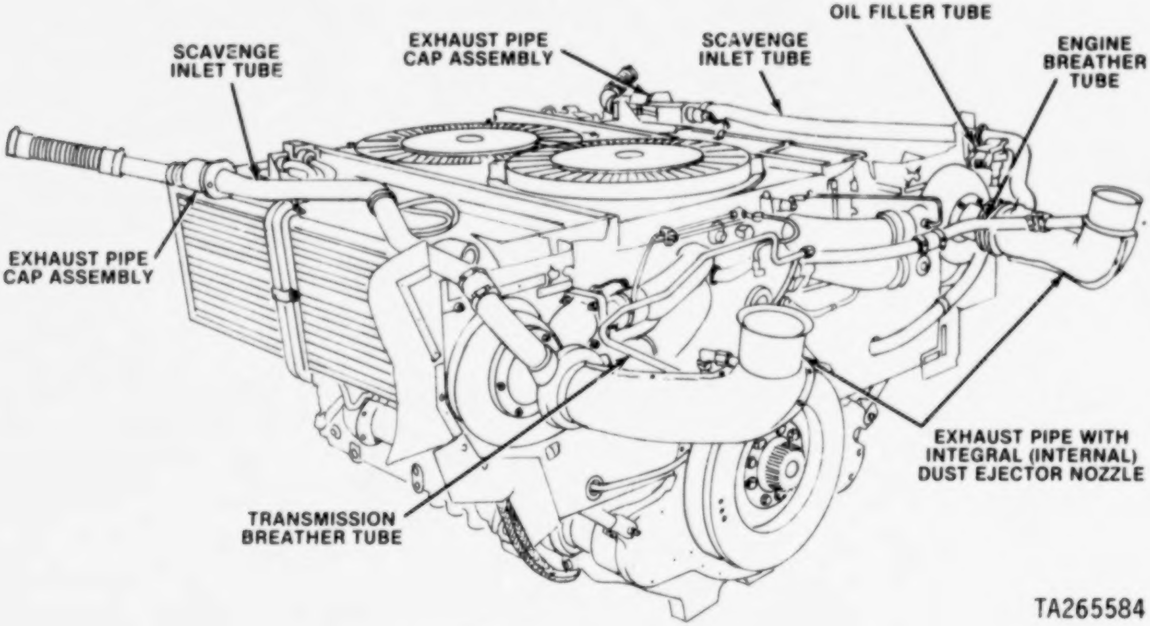

OIL FILLER TUBE
SCAVENGE INLET TUBE
EXHAUST PIPE CAP ASSEMBLY
SCAVENGE INLET TUBE
ENGINE BREATHER TUBE
EXHAUST PIPE CAP ASSEMBLY
EXHAUST PIPE WITH INTEGRAL (INTERNAL) DUST EJECTOR NOZZLE
TRANSMISSION BREATHER TUBE
TA265584

Figure 4-4. Dust Ejector System

Section II. TROUBLESHOOTING.

4-4. Troubleshooting Procedures

Troubleshooting procedures for the Clean Air System are in a tabular format. When an abnormal Dust Detector or Dust Ejector System condition exists, probable causes are listed. The causes are listed in order of most frequent occurrence or in logical sequence for ease and time of accomplishment. Corrective actions are listed for each probable cause. The actions are in logical sequence for accomplishment.

Table 4-1. Troubleshooting Procedures.

Malfunction	Probable cause	Corrective action
1. Abnormal Operations of Dust Detector System (power plant warning lamp and dust detector warning lamps "ON", with pressure switch plunger(s) visible.	a. Restricted filter strip.	a. Service dust detector filter strip, refer to pertinent vehicle technical manual.
	b. Loose or defective hose clamps on turbosupercharger air inlet hose.	b. Repair or replace as necessary.
	c. Defective or missing seals at turbosupercharger air inlet elbow or air cleaner air outlet elbow.	c. Refer to b. above.
	d. Restricted orifices in turbosupercharger compressor housing and cover.	d. Remove dust detector filter strip cover. Clean all orifices and cavities. Service filter strip, refer to a. above.
	e. Defective pressure switch.	e. Remove pressure switch (para 4-6a. 2-6). Refer to paragraph 4-11c. and d. for operational check. If switch is inoperable, replace switch.
	f. Defective wiring harness.	f. Inspect electrical leads for broken wire or damaged connectors. Check for continuity using a voltmeter. Replace defective cable assembly (para 4-11b.).
	g. Air cleaner access door seals damaged or cam arm pins worn or broken.	g. Repair or replace as necessary, refer to pertinent vehicle technical manual.
	h. Leak in engine induction system (turbosupercharger compressor housing and engine air induction manifold.	h. Inspect engine turbouspercharger and manifold system. Clean, tighten, or replace parts as necessary (para 2-28.)
	i. Oil leakage from turbosupercharger compressor side bearing and seal.	i. Repair turbosupercharger as shown in TM9-205-34&P, and TM9-2990-206-34&P, or replace turbosupercharger (para. 2-20).
	j. Ingestion of recirculated smoke / fuel caused by missing/broken air cleaner access door seals or components.	j. Refer to a. above.
	k. Ingestion of recirculated exhaust smoke caused by missing/broken air cleaner access door seals or components.	k. Service filter strip, a. above. Refer to b. above.
	l. Air cleaner filter damaged or punctured due to installation, disassembly, or foreign objects.	l. Service air cleaner, refer to pertinent vehicle technical manual.
2. Abnormal Operation of Dust Ejector System (air cleaner requires cleaning too often).	a. Restricted air cleaner (air cleaner restriction indicators have reached 30 inches H_2O).	a. Service air cleaner, refer to pertinent vehicle technical manual.
	b. Leak in vehicle exhaust dust ejector system due to loose or missing clamps or damaged hoses and gaskets.	b. Inspect, clean, tighten, and replace parts as necessary. Refer to pertinent vehicle technical manual.
	c. Submergence exhaust pipe cap assembly flapper restricting scavenge tube opening· due to flapper hinge pin worn or broken.	c. Replace as necessary. Refer to pertinent vehicle technical manual.

Table 4-1. Troubleshooting Procedures – Continued.

Malfunction	Probable Cause	Corrective action
Abnormal Operation of Dust Ejector System – Continued		
	d. Submergence exhaust pipe cap assembly flapper restricting tube opening due to water freezing flapper in closed position.	d. Repair or replace as necessary. Refer to pertinent vehicle technical manual.
	e. Scavenge system not functioning due to punctured or damaged tubes.	e. Refer to d. above.
	f. Exhaust dust ejector nozzle worn or damaged due to operation, installation, or disassembly.	f. Refer to d. above.
3. Low power and excessive black smoke.	a. Leak in engine air induction system or defective turbosupercharger.	a. Inspect engine air induction system and clean, tighten, or replace parts as necessary (para 2-20, 2-28, and 2-46 .)
	b. Restricted air cleaner (air cleaner restriction indicators have reached 30 inches H_2O).	b. Service air cleaners, refer to pertinent vehicle technical manual.

Section III. REMOVAL AND INSTALLATION OF DUST DETECTOR AND DUST EJECTOR SYSTEM COMPONENTS

4-5. General.

a. Refer to paragraph 2-15 for specific instructions regarding cleanliness, gaskets, torque tightening, and safety devices.

b. This chapter covers removal and replacement of dust detector and dust ejector components for service. Engines which have been removed from vehicles for component service should be thoroughly cleaned before replacement of any component is attempted.

c. Refer to pertinent vehicle technical manuals for instructions on the removal or installation of the power plant, and for separation of the engine from the transmission if necessary.

4-6. Dust Detector System.

a. Removal.

NOTE

Similar procedures are required to remove the left and righ halves of the dust detector system. For instructional purposes, removal of the right bank of the dust detector system is described.

(1) Remove three assembled washer bolts (fig. 4-5) and three loop clamps.

(2) Remove capscrew (fig. 4-6). Disconnect electrical cable connector from pressure switch.

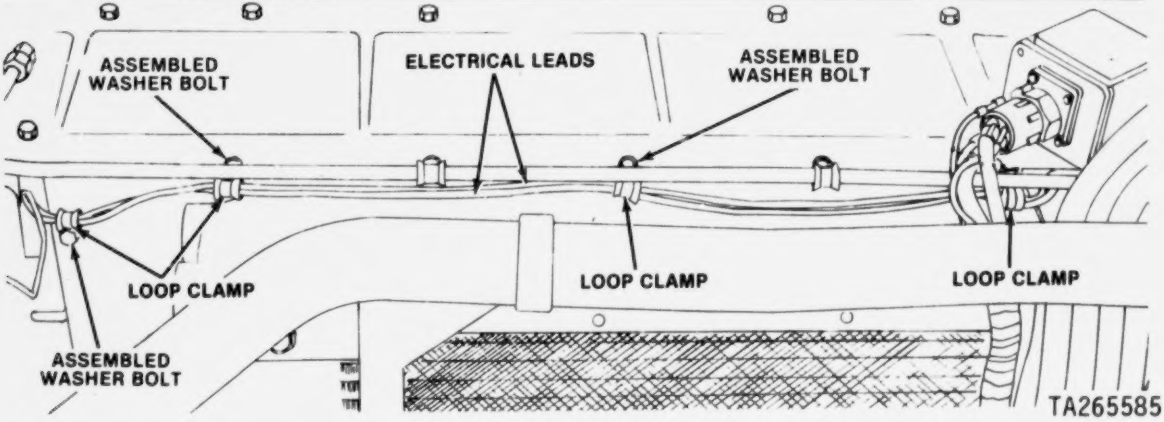


Figure 4-5. Removing or Installing Starter, Smoke and Dust Detector Electrical Cable

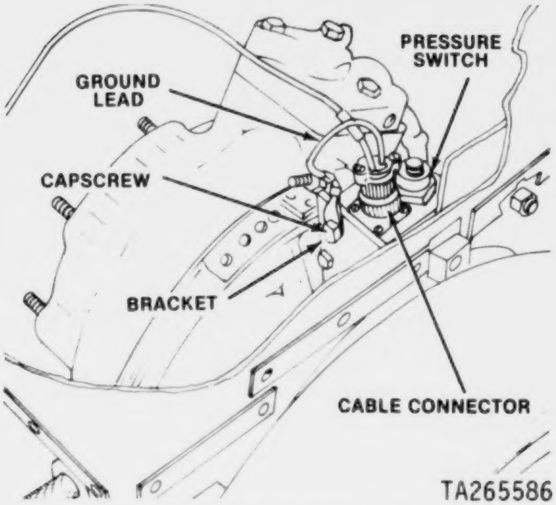

PRESSURE SWITCH
GROUND LEAD
CAPSCREW
BRACKET
CABLE CONNECTOR
TA265586

Figure 4-6. Removing or Installing Starter and Dust Detector Electrical Cable

(3) Cut and remove two tie wraps (fig. 4-7).

(4) Remove two self-locking nuts (fig. 4-8) and two loop clamps. Remove two clamps from electrical leads. Disconnect two electrical connectors from solenoid valves. Remove self-locking nut and capscrew securing ground lead to solenoid valve bracket.

(5) Disconnect and remove two air pressure hoses (fig. 4-9) from the right bank pressure switch and turbosupercharger. Remove capscrew and lockwasher and remove pressure switch and bracket, as an assembly.

(6) Remove two capscrews (fig. 4-10) and lockwashers, and separate pressure switch from bracket. Remove two adapters and remove and discard two preformed packings.

NOTE

The left bank pressure switch may be removed in a similar manner.

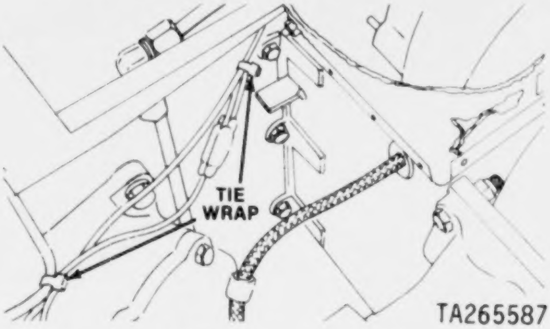

TIE WRAP
TA265587

Figure 4-7 Removing or Installing Smoke and Dust Detector Electrical Cables

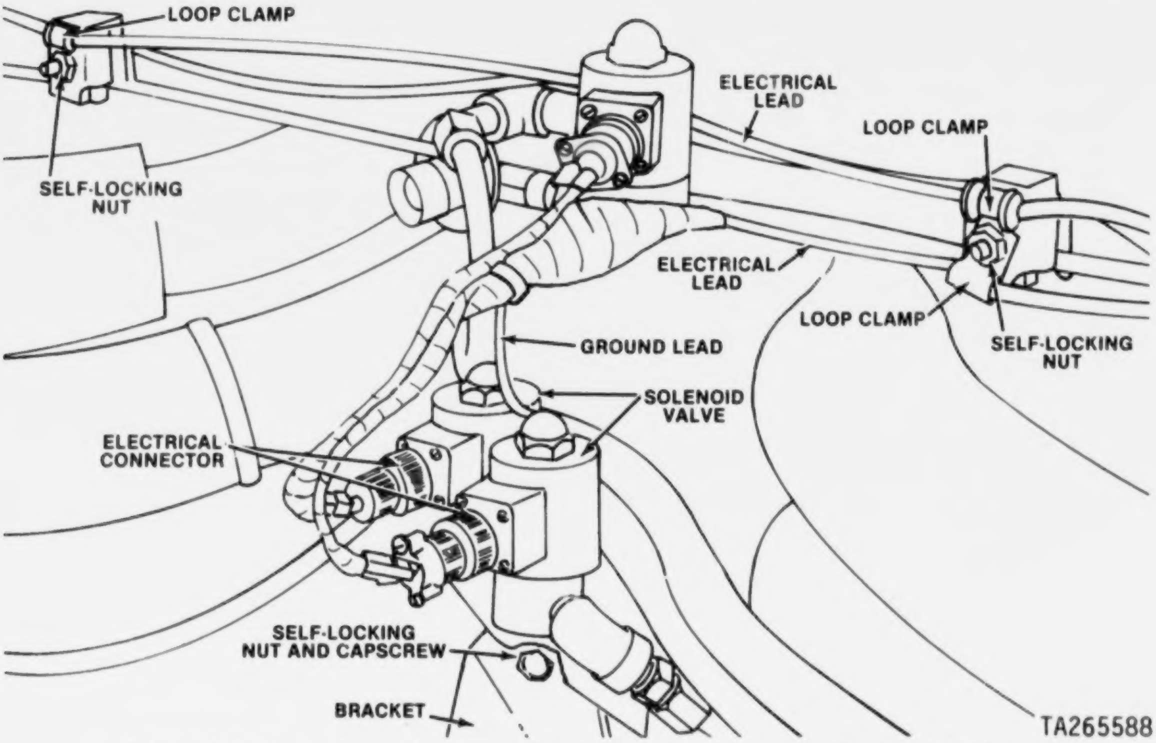

LOOP CLAMP
ELECTRICAL LEAD
LOOP CLAMP
SELF-LOCKING NUT
ELECTRICAL LEAD
LOOP CLAMP
SELF-LOCKING NUT
GROUND LEAD
SOLENOID VALVE
ELECTRICAL CONNECTOR
SELF-LOCKING NUT AND CAPSCREW
BRACKET
TA265588

Figure 4-8 Removing or Installing Smoke and Dust Detector Electrical Cable

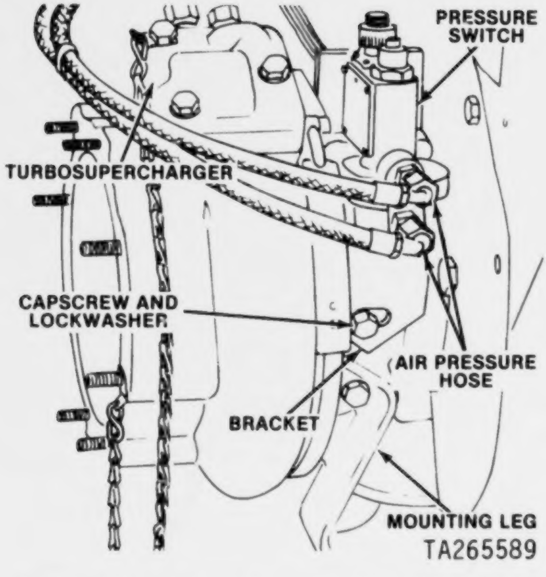

PRESSURE SWITCH
TURBOSUPERCHARGER
CAPSCREW AND LOCKWASHER
AIR PRESSURE HOSE
BRACKET
MOUNTING LEG
TA265589

Figure 4-9. Removing or Installing Right Bank Dust Detector Pressure Switch

b. Installation.

(1) Install two new preformed packings (fig. 4-10) and two adapters. Position right bank pressure switch on bracket and secure with two capscrews and lockwashers.

(2) Install assembled pressure switch (fig. 4-9) and bracket on turbosupercharger mounting leg and secure with capscrew and lockwasher. Connect two air pressure hoses to pressure switch and turbosupercharger.

NOTE

The left bank pressure switch may be installed in a similar manner.

(3) Connect electrical cable connector (fig. 4-11) to pressure switch. Position ground lead on bracket and secure with capscrew.

(4) Install two loop clamps (fig. 4-8) on electrical leads. Secure loop clamps to capscrews with two self-locking nuts. Connect electrical connectors to solenoid valves. Position ground lead behind bracket and secure with capscrew and self-locking nut.

(5) Install two new tie wraps (fig. 4-7).

(6) Install three loop clamps (fig. 4-5) on electrical leads. Secure clamps with three assembled washer bolts.

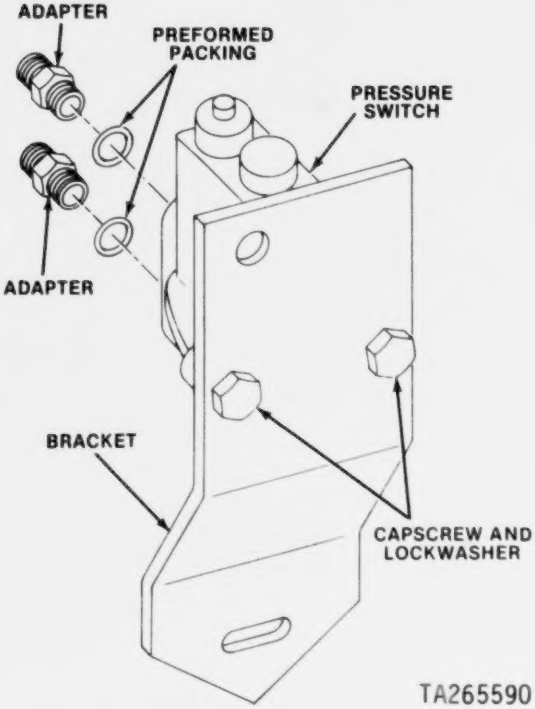

ADAPTER
PREFORMED PACKING
PRESSURE SWITCH
ADAPTER
BRACKET
CAPSCREW AND LOCKWASHER
TA265590

Figure 4-10 Removing or Installing Dust Detector Pressure Switch

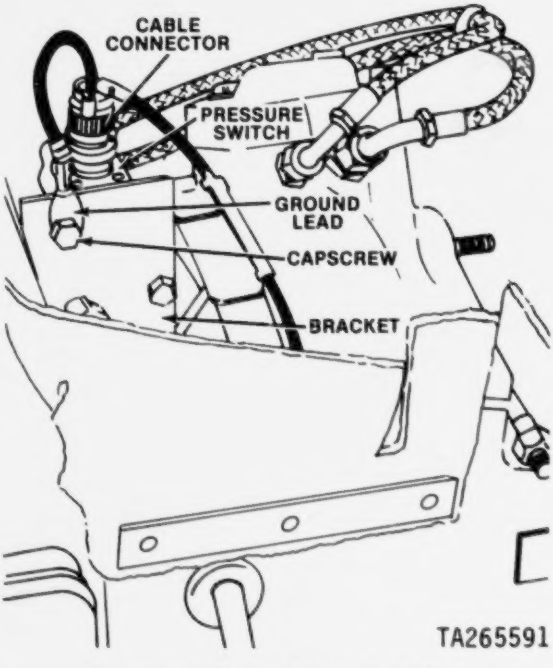

CABLE CONNECTOR
PRESSURE SWITCH
GROUND LEAD
CAPSCREW
BRACKET
TA265591

Figure 4-11. Removing or Installing Smoke and Dust Detector Cables

(7) Install retaining strap (fig. 4-12) and secure with two capscrews and lockwashers. Install cable connector through support with connector key at the 3 o'clock position. Secure connector with four plain nuts, lockwashers, and machine screws.

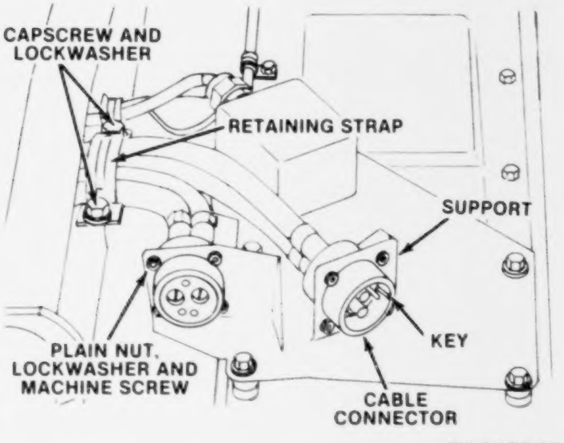

CAPSCREW AND LOCKWASHER
RETAINING STRAP
SUPPORT
KEY
PLAIN NUT, LOCKWASHER AND MACHINE SCREW
CABLE CONNECTOR
TA265592

Figure 4-12. Removing or Installing Starter, Smoke, and Dust Detector Electrical Cable Connector

(8) Install two retaining straps (fig. 4-13) and secure two loop clamps and mounting bracket with four capscrews and lockwashers.

4-7. Dust Ejector System.

a. Removal.

NOTE

Similar procedures are required to remove the left and right dust ejector systems. For instructional purposes, removal of the left bank dust ejector system is described. Removal procedures for the right bank dust ejector system are similar except for the engine breather tube and transmission breather tube.

(1) Left bank.

(a) Loosen two hose clamps (fig. 4-14). Remove machine bolt and self-locking nut from loop clamp and bracket. Remove loop clamp. Remove six self-locking nuts and remove ejector tube. Remove and discard gasket.

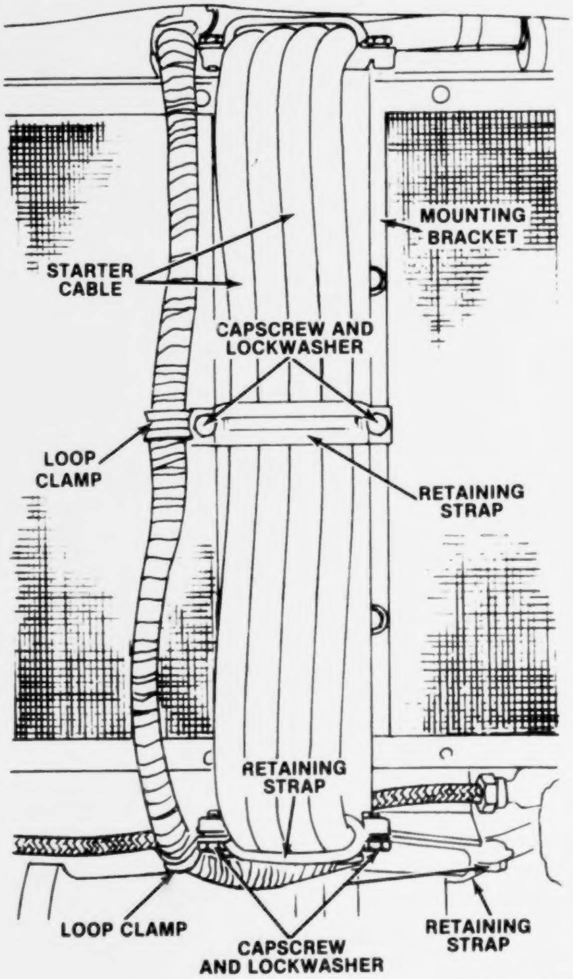

MOUNTING BRACKET
STARTER CABLE
CAPSCREW AND LOCKWASHER
LOOP CLAMP
RETAINING STRAP
RETAINING STRAP
LOOP CLAMP
CAPSCREW AND LOCKWASHER
RETAINING STRAP
TA265593

Figure 4-13. Removing or Installing Starter, Smoke and Dust Detector Electrical Cable

(b) Remove two capscrews and self-locking nuts (fig. 4-15). Remove scavenge tube and exhaust pipe cap assembly.

(2) Right bank.

(a) Loosen nut (fig. 4-16) and remove transmission breather tube. Remove elbow from ejector tube.

(b) Remove the right bank dust ejector system in a manner similar to paragraph (1) above.

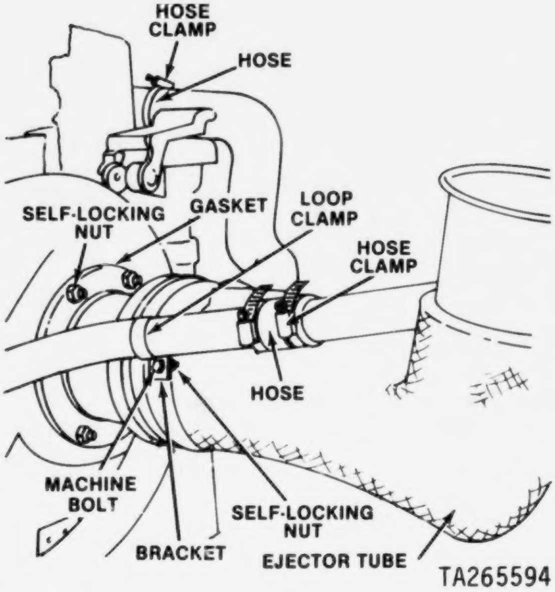

HOSE CLAMP
HOSE
SELF-LOCKING NUT
GASKET
LOOP CLAMP
HOSE CLAMP
HOSE
MACHINE BOLT
BRACKET
SELF-LOCKING NUT
EJECTOR TUBE
TA265594

Figure 4-14. Removing or Installing Dust Ejector Exhaust Pipe

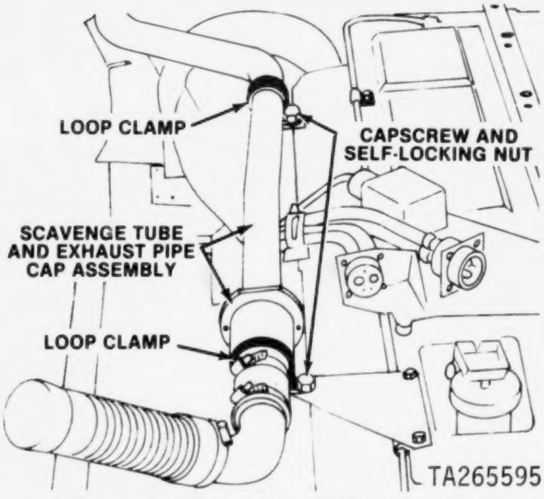

LOOP CLAMP
CAPSCREW AND SELF-LOCKING NUT
SCAVENGE TUBE AND EXHAUST PIPE CAP ASSEMBLY
LOOP CLAMP
TA265595

Figure 4-15. Removing or Installing Dust Ejector Scavenge Tube and Exhaust Pipe Cap Assembly

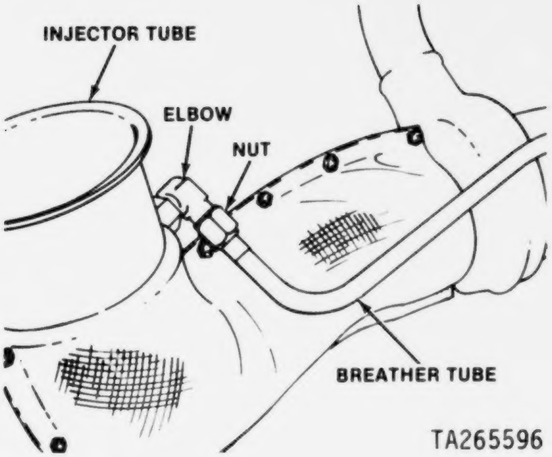

INJECTOR TUBE
ELBOW
NUT
BREATHER TUBE
TA265596

Figure 4-16 Removing or Installing Transmission Breather Tube

b. Installation.

(1) Left bank.

(a) Install ejector tube (fig. 4-14) on turbosupercharger and into hose using new gasket. Secure ejector tube with six self-locking nuts. Install loop clamp on breather tube and secure clamp to bracket with machine bolt and self-locking nut.

(b) Position assembled scavenge tube and exhaust pipe cap assembly (fig. 4-15) onto left bank ejector tube (fig. 4-14) above and parallel to the engine and transmission oil coolers. Secure loop clamps (fig. 4-15) to bracket with capscrews and self-locking nuts. Tighten hose clamps.

(2) Right bank.

(a) Install right bank dust ejector system in a manner similar to paragraph (1) above.

(b) Install elbow (fig. 4-16) in ejector tube. Install transmission breather tube on elbow and tighten nut.

Section IV. REPAIR OF DUST DETECTOR SYSTEM

4-8. General.

This section covers the repair of the dust detector system. Refer to paragraphs 3-35 through 3-41 for general repair procedures. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair instructions.

4-9. Disassembly.

Refer to paragraph 4-6 for removal of the dust detector components from the engine. The pressure switch (1, fig. 4-17), bracket (2), air hoses (5, 6, 8, and 9) adapters (10 and 13), and preformed packings (11 and 12) were removed and disassembled during replacement of dust detector components for service (para 4-6).

4-10. Cleaning.

Refer to paragraph 3-36.

4-11. Inspection and Repair.

a. Refer to paragraphs 3-37 and 3-38 for general inspection and repair.

b. Wiring harness repair is limited to replacement of faulty connectors and to the substitution of a jumper wire for a defective harness wire. When repair is necessary, free the lead, harness, or cable only insofar as necessary to perform the repair. Refer to figures 3-305, 3-306, and 3-307 for instructions concerning replacement of cable connectors, female plugs, male plugs, and female receptacles.

c. Install an adapter (13, fig. 4-17) in the bottom (low pressure) opening in pressure switch (1). Suck on connector with the mouth. The pressure switch plunger (1, fig. 4-17) must pop up. If the plunger does not pop up, remove adapter and replace pressure switch.

d. Using a voltmeter, check for continuity across the two pressure switch connector pins. If there is no continuity, replace pressure switch (1, fig. 4-17).

4-12. Assembly.

The dust detector components and electrical harness will be assembled during engine assembly, paragraph 4-6*b*.

Section V. REPAIR OF DUST EJECTOR SYSTEM

4-13. General.

This section covers the repair of the dust ejector system. Refer to paragraphs 3-25 through 3-41 for general repair procedures. Specific instructions on disassembly, cleaning, inspection, and assembly accompany the repair instructions.

4-14. Disassembly.

Refer to paragraph 4-7 for removal of the dust ejector components from the engine.

a. Left bank.

(1) Loosen hose clamp (5, fig. 4-18), that is nearest the left bank ejector tube (28).

(2) Remove 2 machine bolts (15) and self-locking nuts (19) from loop clamps (16 and 22). Remove exhaust assembly from engine.

(3) Loosen remaining hose clamps (5). Separate and remove hoses (6, 12, 13) and tube (20). Remove hose clamps (5, 16, 22).

(4) Scribe alinement marks on flanges of exhaust pipe cap assembly (11) and scavenge tube (25).

(5) Remove capscrew (8), lockwasher (9), machine bolt (15), and lockwasher (21) and separate exhaust pipe cap assembly (11) from scavenge tube (25). Remove and discard gasket (10).

(6) Loosen two hose clamps (39).

(7) Remove breather tube (41), hose (40), and two clamps (39).

(8) Remove 11 machine screws (1), plain nuts (31), lockwashers (30), and flat washers (2).

(9) Remove and discard insulators (26 and 29).

b. Right bank.

(1) Loosen hose clamp (5, fig. 4-18) that is nearest the right bank ejector tube (4).

(2) Remove 2 machine bolts (15) and self-locking nuts (19) from loop clamps (16 and 22). Remove exhaust assembly from engine.

(3) Loosen remaining hose clamps (5). Separate and remove hoses (6, 12, 13) and tube (14). Remove hose clamps (5, 16, 22).

(4) Scribe alinement marks on flanges of exhaust pipe cap assembly (11) and scavenge tube (7).

(5) Remove capscrew (8) and lockwasher (9) and machine bolt (15) and lockwasher (21) and separate exhaust pipe cap assembly (11) from scavenge tube (7). Remove and discard gasket (10).

(6) Disconnect and remove transmission breather tube (33) from elbow (34).

(7) Remove elbow (34) from right bank ejector tube (4) and transmission.

(8) Remove 11 machine screws (1), plain nuts (31), lockwashers (30), and flat washers (2).

(9) Remove and discard insulators (3 and 32).

4-15. Cleaning.

Refer to paragraph 3-36.

4-16. Inspection and Repair.

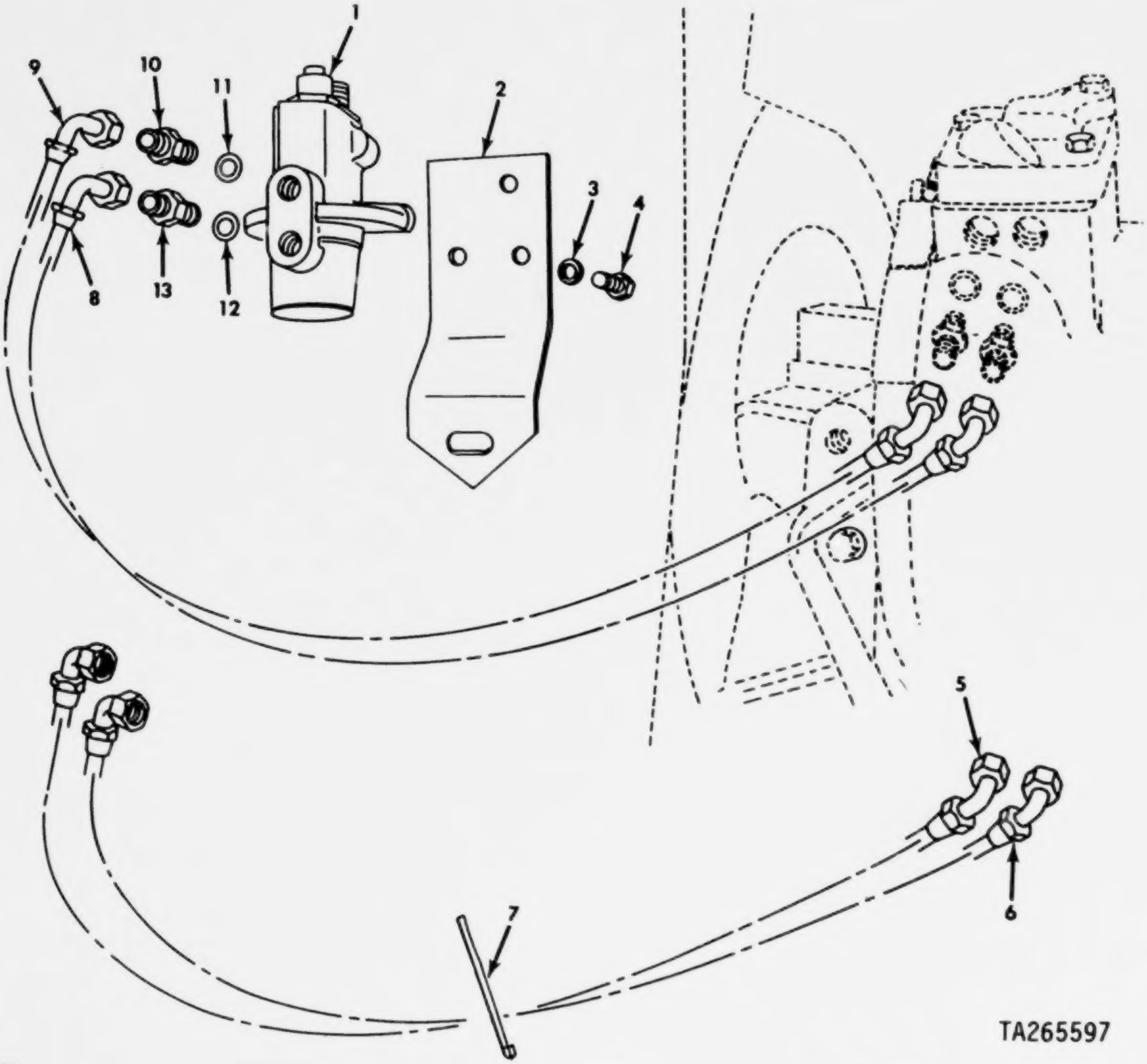
a. Refer to paragraphs 3-37 and 3-38 for general inspection and repair.

b. Inspect tubes (7, 14, 20, 25, 33, and 41, fig. 4-18) for erosion, cracks, broken welds, and damaged flanges. Inspect welded breather tube on left ejector tube (28), transmission breather tube

(33), and elbows (34 and 37) for carbon build-up. Remove carbon. If carbon cannot be removed, replace parts. Replace damaged parts.

c. Inspect exhaust pipe cap assembly flapper valve and pivot pins for erosion, wear, or looseness. Replace eroded or damaged parts.

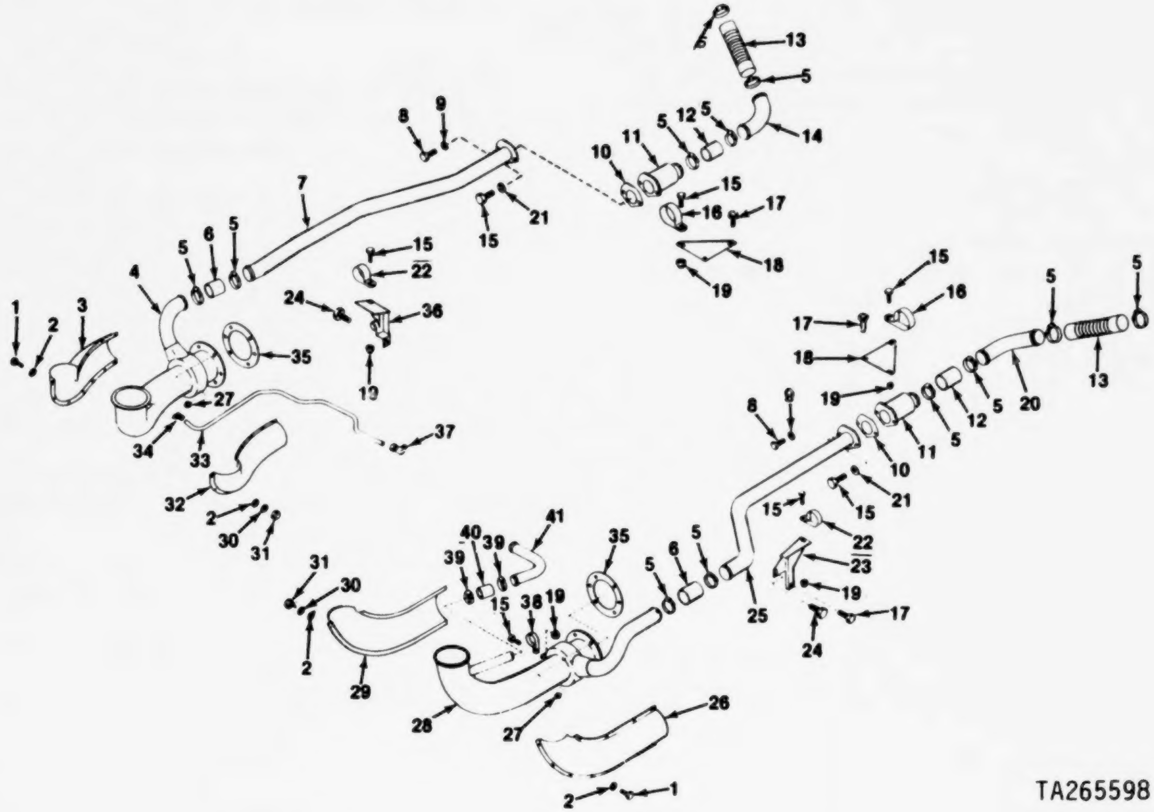
d. Inspect ejector tubes (4 and 28, fig. 4-18) for erosion and cracks. Check for broken welds at all seams and at angle bracket (23). Replace ejector tubes (4 and 28) if damaged.



ITEM NO.	DESCRIPTION
1	SWITCH, PRESSURE: AIR, LEFT AND RIGHT BANK
2	BRACKET, MOUNTING: AIR PRESSURE SWITCH, LEFT AND RIGHT
3	WASHER, LOCK: AIR PRESSURE SWITCH TO BRACKET, LEFT AND RIGHT
4	SCREW, CAP, HEXAGON HEAD: AIR PRESSURE SWITCH, TO BRACKET, LEFT AND RIGHT
5	HOSE ASSEMBLY, NONMETALLIC: LOW PRESSURE SWITCH INLET, RIGHT
6	HOSE ASSEMBLY, NONMETALLIC: HIGH PRESSURE SWITCH INLET, RIGHT
7	STRAP, TIE-DOWN, ELECTRICAL COMPONENTS: AIR PRESSURE SWITCH HOSE, INLET AND OUTLET, RIGHT

ITEM NO.	DESCRIPTION
8	HOSE ASSEMBLY, NONMETALLIC: HIGH AIR PRESSURE SWITCH, LEFT
9	HOSE ASSEMBLY, NONMETALLIC, LOW AIR PRESSURE SWITCH, LEFT
10	ADAPTER, STRAIGHT, TUBE TO BOSS: HIGH AIR PRESSURE SWITCH, INLET
11	PACKING, PREFORMED: LOW AIR PRESSURE SWITCH ADAPTER, INLET,PART OF SET PART NUMBER 5704488
12	PACKING, PREFORMED: HIGH AIR PRESSURE SWITCH ADAPTER, OUTLET, PART OF SET PART NUMBER 5704488
13	ADAPTER, STRAIGHT, TUBE TO BOSS: LOW AIR PRESSURE SWITCH, OUTLET

Figure 4-17. Dust Detector System



ITEM NO.	DESCRIPTION
1	SCREW, MACHINE: INSULATION, LEFT AND RIGHT EJECTORS
2	WASHER, FLAT: INSULATION, TO EXHAUST EJECTORS
3	INSULATION: PIPE FITTING COVERING TERMINAL: OUTER RIGHT
4	TUBE, EJECTOR: RIGHT
5	CLAMP, HOSE: SCAVENGE AIR REAR TUBE TO EXHAUST EJECTOR HOSE (4) SCAVENGE AIR FRONT TUBE TO CAP ASSEMBLY HOSE (4) SCAVENGE AIR FRONT TUBE TO VEHICLE AIR CLEANER CONNECTION (4)
6	HOSE, NONMETALLIC: SCAVENGE AIR REAR TUBE TO EJECTOR
7	TUBE ASSEMBLY, METAL FRONT SCAVENGE AIR, RIGHT
8	SCREW, CAP, HEXAGON: SCAVENGE AIR REAR TUBE TO CAP ASSEMBLY
9	WASHER, LOCK: SCAVENGE AIR REAR TUBE TO CAP ASSEMBLY (2) SCAVENGE AIR REAR TUBE CLAMP TO BRACKET (2)
10	GASKET: CAP ASSEMBLY, MOUNTING, PART OF SET PART NO. 5704488
11	CAP ASSEMBLY, EXHAUST AIR PROTECTIVE, MUFFLER, EXHAUST PIPE
12	HOSE, AIR DUCT, RUBBER: SCAVENGE AIR FRONT TUBE TO CAP ASSEMBLY
13	HOSE, AIR DUCT: SCAVENGE AIR FRONT TUBE TO VEHICLE AIR CLEANER CONNECTION
14	TUBE, BENT, METALLIC: SCAVENGE AIR, FRONT RIGHT
15	BOLT, MACHINE: CRANKCASE BREATHER TUBE CLAMP TO EXHAUST EJECTOR, LEFT (1) SCAVENGE AIR REAR TUBE TO CAP ASSEMBLY (2) SCAVENGE AIR FRONT AND REAR TUBE CLAMP TO BRACKET (4)
16	CLAMP, LOOP: CAP ASSEMBLY SCAVENGE AIR TUBE BRACKET
17	SCREW, ASSEMBLED, WASHER: SCAVENGE AIR REAR TUBE BRACKET TO OIL COOLER, LEFT (1) SCAVENGE AIR FRONT TUBE BRACKET TO UPPER COVER LEFT (2) RIGHT (1)
18	BRACKET, MOUNTING: SCAVENGE AIR TUBE, FRONT
19	NUT, SELF-LOCKING HEXAGON: CRANKCASE BREATHER TUBE CLAMP TO EXHAUST EJECTOR, (1) SCAVENGE AIR FRONT AND REAR TUBE CLAMP TO BRACKET (1)
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25	TUBE ASSEMBLY, METAL: SCAVENGE AIR, REAR
26	INSULATION SLEEVING: OUTER LEFT BANK, THERMAL
27	NUT, SELF-LOCKING HEXAGON: EXHAUST EJECTOR TO TURBOSUPERCHARGER
28	TUBE EJECTOR: LEFT
29	INSULATION SLEEVING: INNER LEFT BANK, THERMAL
30	WASHER, LOCK: INSULATION, TO EXHAUST EJECTORS
31	NUT, PLAIN: INSULATION, LEFT AND RIGHT EJECTORS
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40	HOSE, AIR DUCT: CRANKCASE BREATHER TO EJECTOR
41	TUBE, BENT METALLIC: CRANKCASE BREATHER, INTERMEDIATE

Figure 4-18. Dust Ejector System

4-17. Assembly.

a. Left Bank.

(1) Install new insulators (26 and 29, fig. 4-18) on left bank ejector tube (28) and secure with 11 machine screws (1), lockwashers (30), plain nuts (31), and 22 flat washers (2).

(2) Install breather tube (41) on left bank ejector tube (28) and secure with new hose (40) and two hose clamps (39).

(3) Slide one clamp (5) over ejector tube (28) exhaust pipe.

(4) Position new gasket (10) and aline the alinement marks on flanges of exhaust pipe cap assembly (11) and scavenge tube (25). Secure with capscrew (8) and lockwasher (9) and machine bolt (15) and lockwasher (21).

(5) Position loop clamps (16 and 22) onto scavenge tube (25) and exhaust pipe cap assembly (11).

(6) Assemble hoses (6, 12, 13), tube (20) and hose clamps (5). Secure hoses (6, 12, 13) and tube (20) by tightening hose clamps (5).

(7) Position exhaust assembly parallel to the engine and transmissionoil coolers and slide hose (6) onto ejector tube (28) exhaust pipes.

(8) Secure exhaust assembly to engine using 2 machine bolts (15) and self-locking nuts (19) through loop clamps (16 and 22) and brackets (18 and 23).

(9) Position clamp (5) over hose (6) and tighten.

b. Right bank.

(1) Install new insulators (3 and 37) on right bank ejector tube (4) and secure with 11 machine screws (1), lockwashers (30), plain nuts (31), and 22 flat washers (2).

(2) Slide one clamp (5) over ejector tube (4) exhaust pipe.

(3) Position new gasket (10) and aline the alinement marks on flanges of exhaust pipe cap assembly (11) and scavenge tube (7). Secure with capscrew (8) and lockwasher (9) and machine bolt (15) and lockwasher (21).

(4) Position loop clamps (16 and 22) onto scavenge tube (7) and exhaust pipe cap assembly (11).

(5) Assemble hoses (6, 12, 13), tube (14) and hose clamps (5). Secure hoses (6, 12, 13) and tube (14) by tightening hose clamps (5).

(6) Position exhaust assembly parallel to the engine and transmission oil coolers and slide hose (6) onto ejector tube (4) exhaust pipe.

(7) Secure exhaust assembly to engine using 2 machine bolts (15) and self-locking nuts (19) through loop clamps (16 and 22) and brackets (18 and 36).

(8) Position clamp (5) over hose (6) and tighten.

(9) ,Attach transmission breather tube (33) to ejector tube (4) using elbow (34).

Section VI. ENGINE TEST AND ADJUSTMENT.

Refer to Chapter 3, Section XXIX.

APPENDIX A
REFERENCES

A-1 Publication Indexes

DA PAM 310-1	Index of Administrative Publications
DA PAM 310-2	Index of Blank Forms
DA PAM 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals, Supply Bulletins and Lubrication Orders
DA PAM 310-6	Index of Supply Catalogs and Supply Manuals
DA PAM 310-7	Index of Modification Work Orders

A-2 Maintenance Forms and Records

DA Form 2028	Recommended Changes to Publications
DD Form 1397	Processing and Deprocessing for Shipment, Storage and Issue of Vehicles and Spare Engines
TM 38-750	The Army Maintenance Management Systems (TAMMS)

A-3 Technical Manuals

TM 43-0139	Painting Instructions for Field Use
TM 9-214	Inspection, Care, and Maintenance of Antifriction Bearings
TM 9-247	Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel
TM 9-6140-200-14	Operator's, Organizational, Direct Support and General Support Maintenance Manual for Lead-Acid Storage Batteries
TM 9-2520-223-34	Direct Support and General Support Maintenance Manual (Including Repair Parts and Special Tools List) for Transmission Cross Drive Assembly Model CD-850-6A
TM 9-2910-212-34	Direct Support and General Support Maintenance Manual for Pump, Metering, Fuel Injection Assembly 10912447 (2910-00-064-6265) and 11684129 (2910-00-398-9550)(American Bosch Model PSB-12 BT)
TM 9-2910-213-34	Direct Support and General Support Maintenance Manual for Pump, Fuel, Engine, Assembly (Viking Model FV492) 8725131, 8725282, 8725283, 10882763, and 10882763-1
TM 9-2920-232-34	Direct Support and General Support Maintenance Manual (Including Repair Parts List) for Starter Engine (Delco-Remy GMC Model 1109972)
TM 9-2920-252-34& P	DS and GS Maintenance Manual with Repair Parts and Special Tools List for Generator Assembly, Model 30B95-3B and Voltage Regulator Assembly, Model 24B30-3B
TM 9-2990-205-34& P	DS and GS Maintenance Manual with Repair Parts and Special Tools List for Turbosupercharger Model 5HDR

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FRED C. WEYAND
General, United States Army
Chief of Staff

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Engine with container,
AVDS-1790-2C, 2D and 2DR

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PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.
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IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

The figure title for figure 3-308 is correct. However, the illustration is incorrect. The illustration shown on page 3-328 should be on page 3-221, and figure 3-334 should be deleted.

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THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

TEMPERATURE

$5/9\,(^{0}F - 32) = {}^{0}C$
212^{0} Fahrenheit is equivalent to 100^{0} Celsius
90^{0} Fahrenheit is equivalent to 32.2^{0} Celsius
32^{0} Fahrenheit is equivalent to 0^{0} Celsius
$9/5\,C^{0} + 32 = F^{0}$

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621

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